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Latino kindergarteners' math growth, approaches to learning, and home numeracy practices

Diana Leyva [a,*], Gloria Yeomans-Maldonado [b], Christina Weiland [c], Anna Shapiro [d]

[a] University of Pittsburgh, Pittsburgh, PA, USA
[b] Children's Learning Institute at The University of Texas Health Science Center at Houston, Houston, TX, USA
[c] University of Michigan, Ann Arbor, MI, USA
[d] University of Virginia, Charlottesville, VA, USA

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ABSTRACT

There is limited research on the relation between approaches to learning (ATL) and Latino kindergarteners' math development, and mixed results regarding the role of Latino home numeracy practices. This study examined the associations among Latino kindergarteners' ATL, home numeracy practices, and growth in math skills. Participants were 151 low-income Latino parents and their children (*M* age = 67 months; 52% female). In early fall (beginning of kindergarten), parents completed a home numeracy survey and children's ATL were assessed. At three time points during the kindergarten year (early and late fall, and spring), children's math skills were assessed. Positive linear growth in Latino kindergarteners' math skills was observed. Latino kindergarteners' ATL positively related to variation in math skills, but not growth. Home numeracy practices did not relate to math skills. Findings highlight the unique role that ATL might play as an ecocultural asset that supports Latino kindergarteners' math development.

Introduction

Latino[1] children represent a large share of students in the U.S. educational system: they make up about 25% of students in schools and are projected to represent about 30% of the student population by 2050 (U.S. Census Bureau, 2019). In recent years, calls for using a "strengths-based" framework for guiding policy investment in Latino children and their families have increased (Gennetian et al., 2021). A strengths-based framework focuses on the knowledge and skills that racially minoritized and linguistically diverse children have and that may promote development in other knowledge and skills. In contrast, a developmental-risk or deficit framework focuses on the knowledge, skills, and values that children and their families lack. A strengths-based approach is informed by ecocultural theory whereby the *assets* or sets of competencies that racially and linguistically minoritized children develop by participating in routine activities at home and in their communities are central to their learning but are rarely acknowledged by school or society (García-Coll et al., 1996; Perez-Brena, Rivas-Drake, Toomey, & Umaña-Taylor, 2018; Yosso, 2005).

One ecocultural asset that Latino kindergarten children bring to school is their approaches to learning (ATL). ATL refer to a domain general set of competencies that promote learning regardless of the content; these include attention, concentration, engagement, motivation, and task persistence (McDermott, Rikoon, & Fantuzzo, 2014). ATL are the application of executive functioning and social emotional skills to independent and collaborative learning situations across content domains (Bustamante & Hindman, 2020). At kindergarten entry, Latino children score higher in ATL competencies than their African American peers and similary to their White peers (Crosnoe, 2007; Galindo & Fuller, 2010). Latino children's advantages in ATL competencies are thought to be a result of their communities' socialization practices (Bustamante & Hindman, 2020). *Respeto* and *buena educación* (being respectful to others, particularly adults, and displaying good comportment) and *familismo* (contributing to the collective interest of the family) are an integral part of Latino socialization norms (García Coll & Pachter, 2002; Valdés, 1996). Hence, from very early on, Latino children are socialized into actively listening, following the rules, paying attention, collaborating, and persisting on tasks. In addition, Latino families'

* Corresponding author at: Psychology Department, University of Pittsburgh, Sennott Sq., 3rd Floor, 210 S. Bouquet St, Pittsburgh, PA 15260, USA.
E-mail address: dml114@pitt.edu (D. Leyva).

[1] We asked families in the study what term they preferred (i.e., Latino, Latinx, Latine, Latin* or Latin@). All families selected "Latino." To honor families' preferences, we use this term here (see Salinas, 2020; Pew Research Center, 2020 for similar views).

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strong adult-child attachment (Howes & Wishard Guerra, 2009) might also help children have confidence and a strong sense of self-worth independent of task success, promoting persistence and engagement, particularly in challenging tasks (Bustamante & Hindman, 2020).

A small yet growing body of evidence suggests that Latino kindergarteners' strong ATL competencies at school entry are uniquely related to their math development. A study using nationally representative data (ECLS-K 1998–1999 dataset) found that Latino kindergarteners with advanced ATL competencies had larger gains from fall to spring in math skills than those with less advanced ATL (Galindo & Fuller, 2010). Remarkably, ATL was the strongest predictor of gains in Latino kindergarteners' math skills above important environmental factors, including parental education and home language (Galindo & Fuller, 2010). Another study found that children's ATL competencies positively related to gains in academic skills, including math skills, for Latino children but not for non-Latino children (Bustamante & Hindman, 2020). However, the latter study focused on preschool not kindergarten children.

Notably, the link between Latino kindergarteners' ATL and math gains reported in Galindo and Fuller (2010) has not been replicated in other Latino samples. Furthermore, the aforementioned study did not include home numeracy practices, which are a key environmental source of variability in children's math skills at school entry (for reviews see Eason, Scalise, Berkowitz, Ramani, & Levine, 2020; Hornburg, Boriello, Kung, Lin, & Litkowski, et al., 2021) and, as we explain below, might support the math development of children in Latino communities. In addition, the Galindo and Fuller study focused on gains in math using two data time points, which is insufficient to describe the process of change or the shape of each person's individual trajectory (Singer & Willett, 2003). Thus, in this study we aimed to examine the association between Latino kindergarteners' ATL and growth in math skills across three points in time and to investigate the role of home numeracy practices. To our knowledge, this is the second study to examine whether Latino kindergarteners' ATL competencies relate to changes in math skills and the first to include the effects of home numeracy practices. By examining the associations among Latino kindergarteners' ATL, math gains, and home numeracy practices, this study can help inform efforts by community organizations and educators in schools to leverage this ecocultural asset at home and school, recognizing its importance for academic development.

ATL foster math development

ATL are cognitive and social building blocks of academic development (Best, Miller, & Naglieri, 2011; La Paro & Pianta, 2000). Learning complex skills such as math, which involves both conceptual and procedural competencies, requires a great deal of persistence and effort on the part of the child. Children who find math learning activities enjoyable and are enthusiastic about them are more likely to persist in these activities and spend more time on them; thus, they are more likely to benefit from them (Coolahan, Fantuzzo, Mendez, & McDermott, 2000; McClelland, Acock, & Morrison, 2006). Similarly, children who are better at controlling their attention, emotion, and behavior in math learning activities are more likely to benefit from them, more easily mastering math concepts and procedures (Blair & Diamond, 2008; Bulotsky-Shearer, López, & Mendez, 2015). ATL are a set of learning-enhancing behaviors that predict later academic achievement. A study using six large longitudinal datasets (two of which were nationally representative) found that ATL at school entry were modestly but consistently positively associated with later school achievement, even after controlling for school-entry math and literacy skills (Duncan et al., 2007). Importantly, the associations between ATL and academic achievement are independent of cognitive and language abilities (Bustamante & Hindman, 2020; Howse, Lange, Farran, & Boyles, 2003; McClelland, Morrison, & Holmes, 2000; Yen, Konold, & McDermott, 2004).

Growth in children's math skills during kindergarten

Children's math proficiency levels at kindergarten entry vary substantially. While 95% of children master basic math skills at kindergarten entry such as one-to-one counting of 10 objects, identifying some one-digit numerals, and recognizing some geometric shapes, only 58% can count beyond 10, read all one-digit numerals, and recognize a sequence of patterns. Only 23% can recognize the next number in a sequence, read two-digit numerals, solve simple word problems, and identify the ordinal position of an object. Only 4% master more advanced math skills such as solving addition and subtraction problems (Engel, Claessens, & Finch, 2013).

Growth in kindergarteners' math skills is important for setting their developmental trajectories in elementary and middle school (Jordan, Kaplan, Ramineni, & Locuniak, 2009). For example, growth in math skills during the kindergarten year predicts math performance at the end of 1st grade (Jordan, Kaplan, Olah, & Locuniak, 2006) and 5th grade (Claessens, Duncan, & Engel, 2009). Moreover, growth in math skills from preschool to first grade is a stronger predictor of adolescent math achievement than preschool math skills alone (Watts, Duncan, Siegler, & Davis-Kean, 2014).

To our knowledge, there are no studies modeling growth in math skills (using at least three data time points) in Latino children. There are, however, a few studies on gains in Latino kindergarteners' math skills from fall to spring (Galindo & Fuller, 2010; Murphey, Madill, & Guzman, 2017; Reardon & Portilla, 2016). These studies indicate that, on average, Latino kindergarteners' math skills are lower in the fall compared with their White peers. However, significant gains in math skills from fall to spring are observed in Latino children and these gains are similar to those observed in White children (Murphey et al., 2017). Work on socioeconomic status (SES) differences in math development shows a similar trend. Children from low-SES backgrounds display lower math performance at the beginning of kindergarten compared with children from middle-SES backgrounds. However, children from both SES groups have similar rates of growth and thus make comparable progress upon school entry (Jordan et al., 2006).

Taken together, these findings suggest that it is important to study the growth process (i.e., children's ability to learn and acquire math skills during kindergarten), and not simply changes in math from fall to spring. Research on growth processes may be particularly important given that kindergarten appears to close little of the disparity in Latino and White children's math skills. For these reasons, growth in Latino kindergarteners' math skills is one of the foci of this study.

Frequency of Latino home numeracy practices and math skills

Home numeracy practices are the activities that parents and children engage in at home that support children's understanding of number (e.g., cardinality, counting, number identification), such as reading number books, counting objects, playing with math-related toys, and printing numbers (Eason et al., 2020; Hornburg, Boriello, Kung, Lin, & Litkowski, et al., 2021). Home numeracy practices are sustained by cultural beliefs and values (García-Coll et al., 1996; Perez-Brena et al., 2018; Yosso, 2005) and might explain variability in children's math skills at school entry (Eason et al., 2020; Hornburg, Boriello, Kung, Lin, & Litkowski, et al., 2021). Very little work has examined the relation between the frequency of home numeracy practices and children's math skills in Latino communities in the U.S. One study found that, on average, Latino parents from low-SES backgrounds engaged in home numeracy activities between once a week and 1–3 times a month; however, this frequency did not relate to children's math skills (Kung et al., 2021). Two other studies included Latino families (13–34% of their samples were Hispanic, the remaining were White, Black, Asian and/or multiracial), and found that, across all families, there was no association between frequency of home numeracy practices and children's math skills (De Florio & Beliakoff, 2015; Missall, Hojnoski, Caskie, & Repasky, 2015). Notably, all three studies focused on preschool (and not kindergarten) children. It was possible that associations between home numeracy practices and math skills, which were null in preschool, would emerge during kindergarten, as children started formal schooling and parents engaged more often or more intentionally in these practices (La Paro & Pianta, 2000). Furthermore, prior studies did not measure growth over time in math skills. Thus, we explored the association between frequency of home numeracy practices and growth in Latino kindergarteners' math skills.

Early work suggested that Latino parents may engage in home numeracy practices less frequently than parents from other ethnic groups because they view school and home as two separate contexts, and teachers as responsible for teaching academic skills (Suárez-Orozco, Suárez-Orozco, & Todorova, 2008), or because parents may feel unprepared to promote math at home (López & Donovan, 2009). However, recent work challenges those assumptions. For example, a study by Galindo, Sonnenschein, and Montoya-Ávila (2019) found that Latina mothers viewed themselves and other family members (e.g., fathers, siblings) as playing an important role in fostering their preschool to first-grade children's math skills and reported that direct instruction (i.e., teaching and practicing math content and skills) was their preferred way of promoting math at home. In addition, this same study found that one third of mothers reported promoting math in everyday activities, which aligns with previous ethnographic studies of Latino communities (Civil & Andrade, 2002; Gonzalez, Andrade, Civil, & Moll, 2001).

Work in Latin America has yielded mixed results regarding the relation between the frequency of home numeracy practices and children's math skills, which mirrors results in other countries (Hornburg, Boriello, Kung, Lin, & Litkowski, et al., 2021). While some studies find positive associations with both mixed- and high-SES samples (del Río, Susperreguy, Strasser, & Salinas, 2017; Susperreguy, Burr, Xu, Douglas, & LeFevre, 2020), others find null associations within low-SES samples (Susperreguy et al., 2021). This mixed evidence might be due to, in part, to the wide variability in the way the frequency of home numeracy practices have been operationalized and measured across studies (Eason et al., 2020; Hornburg, Boriello, Kung, Lin, & Litkowski, et al., 2021). For example, some studies assess home numeracy practices on a weekly basis and others use a monthly basis. Some studies include only number-related activities (e.g., counting, adding, and subtracting) and others include broad math activities (e.g., spatial reasoning). Thus, more work is needed to advance our understanding of the role of home numeracy practices in Latino children's math development during the first year of formal schooling.

Current study

Given the small yet growing evidence of the role of Latino kindergarteners' ATL competencies in math growth and the very limited research and mixed results regarding the role of home numeracy practices in Latino communities, it is important to examine the relation among Latino kindergarteners' ATL, home numeracy practices, and growth in math skills. We addressed three research questions:

(1) What are the growth trajectories of Latino children's math skills during the kindergarten year?
(2) Are children's ATL related to these trajectories?
(3) Is the frequency of home numeracy practices related to these trajectories?

Method

Participants

The current study uses data from a randomized controlled trial (RCT) study of the Food For Thought Program (Leyva, Weiland, Shapiro, Yeomans-Maldonado, & Febles, 2021; Leyva, Shapiro, Yeomans-Maldonado, Weiland, & Leech, 2022). The Food For Thought program is a four-week, strengths-based, culturally responsive program that focuses on family food routines to support Latino parents in fostering their kindergarten children's academic skills at home. The original study included 261 Latino families and their kindergarten children recruited from 13 Title I elementary schools (schools serving a high percentage of students from low-income households). These schools had 20% or higher of Latino students and were located in the Southeast, in one of the largest school districts in the U.S. Specifically, across the 13 schools, they enrolled 42% Hispanics, 59% economically disadvantaged students, and 14% English learners. Schools were randomized into treatment and control conditions. The original study found positive impacts of the intervention on vocabulary, narrative skills, and approaches to learning but not math skills (Leyva, Weiland, Shapiro, Yeomans-Maldonado, & Febles, 2021Leyva, Shapiro, Yeomans-Maldonado, Weiland, & Leech, 2022). Thus, for the purpose of this study, we combined data across conditions.[2]

The present study included 151 Latino parents (all of whom were primary caregivers; 92% were mothers) and their kindergarten children of the original 261 participating families. This subset of parents had information on at least one item included in the home numeracy questionnaire and had non-missing data for child's date of birth. There were no statistically significant differences between the analytic sample (subset of families included here) and other members of the full sample (subset of families not included here) on covariates, ATL or math outcomes; see Table S1 in the Online Supplementary Material.

On average, children were 66 months old at the beginning of kindergarten ($SD = 3.98$); 52% were female. Table 1 presents family demographic characteristics for those parents with available demographic questionnaire data. About 24% of parents reported having a high school diploma or higher. Only about 11% of parents reported being born in the USA with a large percentage (42%) reporting Mexico as their home country; other countries of origin represented in the data were Honduras (19%), El Salvador (16%), and Guatemala (9%). There were a few families (< 4%) from other Central and South American countries. The majority of families reported that Spanish was the most commonly used language at home (85%). Across our 13 schools and 151 participants, the average number of children per school was 12 ($SD = 5.69$, min = 6, max = 23).

Procedure

Data were collected during 2018–2019 and 2019–2020 across two cohorts (one cohort per year). Child data were collected via direct assessments at three time points during the kindergarten year: early fall (September), late fall (November), and spring (April). While cohort 1's child data collection was completed at the three time points, due to COVID-19 pandemic cohort 2's child data collection was only completed at two time points (early and late fall but not spring). Parent data (cohorts 1 and 2) were collected via surveys at early fall.

Child assessments took place in schools. A team of 20 bilingual assessors pulled out children from the classroom for about 20 min and assessed them individually in a separate classroom or office in the school. As part of the larger study, several academic and social skills were assessed. Here, we focused only on children's ATL assessments (collected in early fall) and math assessments (collected in early fall, late fall, and spring for cohort 1 and in early and late fall for cohort 2). Assessments were conducted in the child's dominant language, which was determined using information provided by teachers, parents, and children at each time point. In early fall, 32% of children completed the assessments in English, while 68% of children completed them in

[2] Because we controlled for school fixed effects (randomization in the RCT was at the school level), we are ultimately controlling for treatment status in our analyses.

Table 1
Descriptive statistics for predictors and covariates (n = 151).

	n	Mean (SD)	Range	Skewness	Kurtosis
Predictors					
Home numeracy practices	151	4.28 (1.65)	0–7	−0.16	2.70
Child approaches to learning (ATL)	141	3.28 (0.70)	1–4	−0.77	2.75
Covariates					
Child is female	151	0.52	0–1	–	–
Age in months	151	66.17 (3.98)	57.44–82.85	0.36	3.47
Parent has a HS diploma or higher	138	0.24	0–1	–	–
Parent was born in the USA	133	0.11	0–1	–	–
Parent was born in Mexico	129	0.42	0–1	–	–
Spanish most used at home	104	0.85	0–1	–	–
Spanish used at all assessment time points	150	0.43	0–1	–	–
English used at all assessment time points	150	0.21	0–1	–	–
Spanish and English used across time points	150	0.36	0–1	–	–
Outcome[a]					
Math skills: Time 1 (Early Fall)	138	0.57 (0.16)	0.20–0.93	−0.01	2.42
Math skills: Time 2 (Late Fall)	146	0.64 (0.16)	0.21–0.92	−0.35	2.45
Math skills: Time 3 (Spring)[b]	51	0.81 (0.14)	0.50–1	−0.33	2.01

Note. Frequency of home numeracy practices involved three items (i.e., teaching numbers, counting, and comparing) based on a 7-point scale (from 0 to 7 times per week). Approaches to Learning (ATL) involved 7 items (e.g., attention, persistence, and motivation during assessments) based on a 4-point scale (almost never to almost always). HS diploma = high school diploma. We do not report standard deviation for dummy (0–1) variables.

[a] Data were collected during the kindergarten year across three time points (early fall, late fall, and spring) and across two years (cohorts). Math skills represent a composite of five skills: (a) comparison by size and length, (b) sorting and classification, (c) number identification, (d) one-to-one correspondence, (e) addition and subtraction.

[b] For cohort 2, spring data were not collected due to COVID-19 pandemic.

Spanish. In late fall, about 41% of children completed the assessment in English and 59% in Spanish. In spring, 61% of children completed the assessment in English and 39% in Spanish.

Measures

Child approaches to learning (ATL)

Children's attention, engagement, persistence, and motivation in learning activities were assessed using seven items taken from the *International Development and Early Learning Assessment-* IDELA (Save the Children, 2017). Assessors were research assistants who used a four-point Likert scale (1 = almost never, 2 = sometimes, 3 = often, 4 = almost always) to rate the extent to which children displayed behaviors such as paying attention, maintaining concentration, not giving up quickly, and being confident and motivated during the entire IDELA assessment. Hence, this is an assessment of children's ATL in the context of an independent assessment of their academic and social skills. The complete set of items can be found in https://idela-network.org/the-idela-tool/. High levels of internal reliability have been reported by prior research (e.g., Cronbach's alpha = 0.94; Wolf & Suntheimer, 2020). In our sample, Cronbach's alpha was 0.92.

Child math skills

Children's basic math skills (i.e., comparison by size and length, sorting and classification, number identification, one-to-one correspondence, addition and subtraction) were assessed using play-based tasks taken from the IDELA (Save the Children, 2017). For each item within a task, the child's correct response was scored as "1" and incorrect as "0." Children received a math score, which was the average of the percent of correct answers in each of the five tasks (see IDELA manual; Save the Children, 2017). High levels of internal reliability have been reported in prior research using this assessment (Cronbach's alpha = 0.79 and ICC = 0.87; Pisani, Borisova, & Dowd, 2015). In our sample, reliability across all items was 0.69 based on standardized Cronbach's alpha and 0.79 based on ordinal alpha. Prior work has established construct validity of these items in relation to the ASQ's problem solving domain (r = 0.48; Pisani, Borisova, & Dowd, 2018) and using factor analysis (Wolf et al., 2017). We selected these play-based tasks because they focused on five foundational math skills for school entry, were relatively quick to administer, and were developed to be administered in low-resource settings; thus, they involved objects that most children, regardless of their SES background, were familiar with (e.g., pebbles, sticks, etc.). Below, we briefly describe each task.

Comparison by size and length was a four-item task that used two picture cards (one with circles and one with sticks of different sizes and length). The child was asked to identify the biggest, the longest, the smallest, and the shortest object.

Sorting and classification was a two-item task that used six picture cards of red and yellow stars and circles. The cards were placed in front of the child in a random order. The child was asked to sort cards into two groups (i.e., sort pictures together that were alike or similar). Once the child sorted them, and without moving the cards, the child was then asked to find another/different way to sort them. Because cards vary in shape and color, they could be sorted using these two criteria. Note however that the child was not told specifically to use shape and color as the sorting criteria. Instead, the child was allowed to figure out the sorting criterion they wanted to use.

Number identification was a 20-item task that used a grid of randomly placed numerals from 1 to 20. The assessor pointed to a numeral and the child was asked to identify it. If the child paused for more than 5 s, the assessor marked the response as incorrect and moved to the next numeral, encouraging the child to continue. The top two rows of the grid involved single-digit numerals, and the bottom two rows involved two-digit numerals. If the child correctly answered 3 or fewer numerals in the first two rows of the grid, the assessment was discontinued.

One-to-one correspondence was a three-item task that used 20 pebbles. The child was presented with the pebbles and the assessor made three requests, each one involving a specific number of pebbles (i.e., "Can you give me 3 pebbles; 8 pebbles; 15 pebbles?). If the child did not answer the first two items correctly, the assessor discontinued the assessment.

Addition and Subtraction was a three-item task that used the pebbles (from the one-to-one correspondence task) and two pictured cards (bicycles and apples). The child was presented with 2 pebbles and then given 2 more pebbles and asked to calculate the total number of pebbles. Next, the child was presented with the pictured card and asked how many bikes would be there if two were added and how many apples would there be if one was taken away.

Frequency of home numeracy practices

As part of the larger project, parents completed a survey about the frequency of engaging in home literacy (six items; e.g., book reading) and numeracy practices (three items). Here we focused on parental responses to the three home numeracy items. The items were: "During a typical week, how often do you: 1) teach numbers to your child; 2) count objects with your child; and 3) ask the child to compare which one is bigger and/or which one has more?" Responses were given on an 8-point scale from 0 (never) to 7 (everyday). Preliminary analyses showed that responses to the three items were highly correlated (*r*s ranged from 0.55 to 0.58, all *p*s < 0.001). Thus, we made a composite measure by averaging responses across the three items. For those parents who missed one or two out of the three home numeracy items, we imputed data at the item level and then created a composite measure (see Missing Data section). Based on Cronbach's alpha, reliability of the home numeracy practices was $\alpha = 0.80$.

We focused on these three home numeracy practices for two reasons. First, as previously mentioned, direct instruction (teaching math content and skills) is the most common way Latino parents report supporting their children's math skills (Galindo et al., 2019). Second, in observational studies of families from diverse SES backgrounds, the most common ways parents promote their children's math skills are by counting, naming (teaching) numbers, and comparing quantities in home activities (Bjorklund, Hubertz, & Reubens, 2004). These parental practices are key to math development because they help children acquire important properties of whole numbers, such as numbers being countable and having successors (Siegler, Thompson, & Schneider, 2011).

Covariates

Across all models, we controlled for the following set of parent and child characteristics: child gender (i.e., female), language of assessments across time points (i.e., assessments administered in Spanish at all time points, assessments administered in English at all time points, assessments administered in Spanish and English across time points), parental education (i.e., high school diploma or higher), home language (i.e., Spanish), and parent's birthplace (i.e., USA; Mexico; a Latin American country other than Mexico). We coded Mexico as a separate category given that almost half (42%) of respondents came from this country.

Missing data

Missing data on covariates and predictors

Percentage of missingness was as follows: 6% for child ATL, 17% for any of the home numeracy practices, and 0–15% for covariate data (except for home language, which was 31%; see Table 1). To account for missingness, we used multiple imputation (100 data sets). We imputed only predictor variables using multivariate normal regressions where the imputation model was specified to include all covariates described in the analytic strategy as well as information on the math outcome (i.e., average of math scores across the three time points). As a robustness check, we replaced missing data with a constant combined with the inclusion of a missing data indicator (What Works Clearinghouse Standards, 2017). Results from this approach are presented under the robustness checks section, after presenting the results of the primary model specification. Both approaches are standard ways of accounting for missing data.

Missing data on outcome

Given that mixed-effects regression models use maximum likelihood (i.e., include any participants with at least one time point), there is no need not impute outcome data. Relying on maximum likelihood is warranted under the missing at random (MAR) assumption. For the outcome data in this study, time 1 (early fall) and time 2 (late fall) had low proportions of missing data (3.3% to 8.6%). For time 3 (spring), there was missing data for 65% of the sample due to COVID-19. Given the nature of the missing data in time 3 and based on Little's MCAR test results, χ^2 ($df = 63$) $= 60.11$, $p = .58$, the MAR assumption was supported.

Data analytic strategy

We estimated the growth trajectories for math using individual growth modeling (Singer & Willett, 2003), specifically a multilevel model for change (i.e., time points nested within children). The three time points were: early fall, late fall, and spring. We used child's age in months as our time indicator (age in months was centered based on the overall mean age at early fall). We first performed an unconditional growth model to examine variation in both intercept and slope without any covariates or predictors with an unconstrained variance-covariance matrix where all random effects were uniquely estimated (i.e., variance for intercept, slope, and covariance between intercept and slope). These models could not be properly estimated. Thus, we specified a simpler set of models where the structure of the covariance matrix of the random effects estimated the variance of the intercept and slope, but not the covariance between intercept and slope, as in our first specification. We used an identity variance-covariance matrix as our final specification due to limited variability (i.e., close to zero and not significant) in the growth trajectories for math (Singer & Willett, 2003).

Thus, our model taxonomy started with an unconditional growth model with an identity variance-covariance matrix (Model 1). Then, we added the set of covariates (Model 2). Next, we added the predictors of interest (i.e., ATL and home numeracy practices) in separate models (Models 3 and 4, respectively). Last, we added both predictors simultaneously to the model (Model 5). All models included school fixed effects and controlled for cohort. Given the little to no residual variance in the slope among the individual growth trajectories, final specifications of growth models predicted variation in intercept but not slope. We used Stata version 16.0 to conduct all analyses. To gauge the size of the associations, we calculated standardized associations (i.e., $beta_x/SD(y)$). Specifically, we divided the unstandardized beta coefficients of the predictor of interests reported in Table 3 by the standard deviation of the intercept based on the unconditional model (see Table 3, Model 1). A similar approach was followed by Galindo and Fuller (2010). In addition, we also calculated the R^2 based on the percent change in intercept variance between a model with the full set of covariates (e.g., child's sex, parent education) compared to a model where we added the predictor of interest.

Results

Descriptive analysis

Table 1 presents the descriptive statistics for predictors and covariates in early fall and math outcomes across the three time points (i.e., early fall, late fall, and spring). There was considerable variability ($SD = 0.70$) in ATL scores in early fall (see Fig. S1 in Online Supplementary Material), with 33% of children displaying attention, persistence and motivation "sometimes" or "almost never," while 67% of children displayed attention, persistence and motivation "often" or "almost always." On average, kindergarteners displayed ATL behaviors often (3.28 out of 4 points), suggesting strong ATL skills at school entry, at least in the context of this assessment. There was variability in children's math skills (*SD*s ranged from 0.14 to 0.16). For example, in early fall, while some children responded to 20% of math items correctly, others answered 93% correctly. Overall, kindergartners increased their math skills from early fall (57% correct) to late fall (64% correct) to spring (81% correct).

There was wide variability ($SD = 1.65$) in the frequency of home numeracy practices (see Fig. S2 in Online Supplementary Material). While 48% of parents reported engaging in these practices more than three times per week and up to 5 times per week, 28% of parents engaged in these practices 0–3 times per week, and 25% of parents engaged in these practices more than 5 times per week and up to 7 times per week. On average, parents engaged in home numeracy practices about 4 days per week (4.28 out of 7 points), suggesting moderate levels of home numeracy support. Skewness and kurtosis statistics (see Table 1) suggest that distributions of scores on children's math and ATL skills and home numeracy were not substantially skewed or peaked (narrowly distributed). A skewness >1.5 or $<$ than -1.5 is considered substantially skewed and a heavy tailed distribution has a kurtosis >3

(West, Finch, & Curran, 1995). Table 2 summarizes the results of Pearson's correlational analyses of all variables included in models. Associations between children's ATL and math skills were all statistically significant ($p < .05$) and ranged from $r = 0.35$ in early fall, $r = 0.19$ in late fall, and $r = 0.43$ in spring. Home numeracy practices did not relate to children's math skills at any of the time points.

RQ1: What are the growth trajectories of Latino children's math skills during the kindergarten year?

Table 3 (Model 1) presents the results of our unconditional growth models. Math skills exhibited a positive and significant linear growth. On average, kindergarteners started with 0.57 correct points in the early fall and grew about 0.02 points ($p < .001$) every month or 0.18 points across a 9-month academic year. Fig. 1 illustrates growth in children's math skills, where the y-axis represents the predicted values for the unconditional growth model and the x-axis represents the age in months of participants. Each line represents a students' growth given their available time points. Despite a few children with nonlinear trajectories, the overall growth patterns in math skills during kindergarten can be described as linear.

RQ2: Are children's ATL related to these trajectories?

Table 3 (Model 3) presents the results of analyses examining whether children's ATL predicted growth in math skills. Given that we found close to zero variability in the trajectories of slopes, we examined the relation between children's ATL and variation in the intercept or starting point (early fall). Children's ATL positively related to the variation in the intercept for math skills, after controlling for covariates. A one-point increase in ATL was associated with an increase of 0.05 points ($\beta = 0.41$, $p = .005$) for math in early fall of kindergarten. Adding ATL into the model explained an additional 7.69% of the variance in math skills, compared to a model where only covariates were included (see Model 2). The standardized coefficient for this association ($\beta = 0.41$) is medium in magnitude.

RQ3: Is frequency of home numeracy practices related to these trajectories?

Table 3 (Model 4) presents the results of analyses including home numeracy practices after controlling for covariates. Overall, the frequency of home numeracy practices did not relate to variation in the intercept for math skills ($\beta = -0.01$, $p = .882$). When both children's ATL and home numeracy practices were entered simultaneously (Table 3, Model 5), no changes in the magnitude of the unique variance in math skills accounted for by children's ATL (7.69%) were found.

Robustness checks

Robustness to an alternative missing data approach

Table S2 in the Online Supplementary Material summarizes results from all models presented above but using an alternative missing data approach. Specifically, instead of relying on multiple imputation, we replaced missing data with a constant combined with the inclusion of a missing data indicator. Results were consistent with our main specification (both in magnitude and significance level), whereby children's ATL positively related to the variation in the intercept for math skills, after controlling for covariates. This suggests that findings from this study are robust to two different approaches (i.e., multiple imputation and missing data flags) to dealing with missing data.

Table 2
Results of correlational analyses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Child is female	1.00													
(2) Age in months	−0.06	1.00												
(3) Parent has a HS diploma or higher	0.13	0.08	1.00											
(4) Parent was born in the USA	0.08	−0.07	0.20*	1.00										
(5) Mexico is parent's home country	−0.07	−0.03	−0.08	0.19*	1.00									
(6) Spanish most used at home	−0.02	0.07	−0.32**	−0.32**	−0.04	1.00								
(7) Spanish used at all assessment time points	0.05	0.09	−0.12	−0.18*	−0.10	0.24*	1.00							
(8) English used at all assessments time points	−0.05	0.04	−0.02	0.10	−0.07	−0.21*	−0.45***	1.00						
(9) English and Spanish used across assessments	0.00	−0.12	0.15+	0.10	0.16+	−0.06	−0.65***	−0.39***	1.00					
(10) Home numeracy practices	−0.15+	0.03	−0.07	−0.02	−0.08	0.05	0.04	−0.08	0.02	1.00				
(11) Child approaches to learning (ATL)	0.09	0.12	0.01	−0.01	−0.04	0.04	0.08	0.00	−0.08	−0.04	1.00			
(12) Math skills: Time 1 (Early Fall)	−0.08	0.18*	0.16+	0.16+	0.04	−0.19+	−0.12	0.00	0.12	−0.04	0.35***	1.00		
(13) Math skills: Time 2 (Late Fall)	−0.06	0.22**	0.18*	0.04	0.01	−0.22*	−0.11	−0.02	0.13	−0.06	0.19*	0.68***	1.00	
(14) Math skills: Time 3 (Spring)	0.20	0.23	0.37**	0.04	−0.22	−0.40*	−0.04	−0.14	0.13	0.02	0.43**	0.54**	0.52***	1.00

Note. $+p < .10$; $*p < .05$; $**p < .01$; $***p < .001$.

Table 3
Results of growth models for math.

	Model 1 unconditional growth			Model 2 adding covariates			Model 3 covariates + ATL			Model 4 covariates + HN			Model 5 covariates + ATL + HN		
	Coef.	SE	*p*-value	Coef.	SE	*p*-value	Coef.	SE	*p*-value	Coef.	SE	*p*-value	Coef.	SE	*p*-value
Intercept	0.53***	0.04	0.000	0.71***	0.08	0.000	0.56***	0.09	0.000	0.72***	0.09	0.000	0.56***	0.11	0.000
Linear slope	0.02***	0.00	0.000	0.02***	0.00	0.000	0.02***	0.00	0.000	0.02***	0.00	0.000	0.02***	0.00	0.000
Female				−0.01	0.02	0.644	−0.02	0.02	0.441	−0.01	0.02	0.629	−0.02	0.02	0.439
Cohort				−0.05+	0.03	0.082	−0.04	0.03	0.115	−0.05+	0.03	0.081	−0.04	0.03	0.115
Parent education				0.01	0.03	0.630	0.01	0.03	0.612	0.01	0.03	0.628	0.01	0.03	0.611
Born in the USA[a]				0.00	0.04	0.999	0.00	0.04	0.970	0.00	0.04	0.996	0.00	0.04	0.969
Born in Mexico[a]				0.00	0.03	0.901	0.00	0.02	0.876	0.00	0.03	0.900	0.00	0.02	0.875
Spanish most used at home				−0.05	0.04	0.182	−0.05	0.04	0.168	−0.05	0.04	0.181	−0.05	0.04	0.168
Spanish used at all assessments[b]				−0.03	0.03	0.373	−0.04	0.03	0.197	−0.03	0.03	0.377	−0.04	0.03	0.199
English used at all assessments[b]				−0.04	0.03	0.272	−0.05	0.03	0.157	−0.04	0.03	0.269	−0.05	0.03	0.157
Children's ATL				–	–	–	0.05**	0.02	0.005	–	–	–	0.05**	0.02	0.005
Home numeracy				–	–	–	–	–	–	0.00	0.01	0.882	0.00	0.01	0.936
Variance components															
Intercept-slope	0.015			0.013			0.012			0.013			0.012		
Residual	0.010			0.010			0.010			0.010			0.010		

Note. +$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$. All models include school fixed effects. *N* across all models is 151.
ATL = Approaches to learning. HN = Home numeracy.
[a] The reference category corresponds to parents who were born in a Latin American country that is not Mexico.
[b] The reference category corresponds to students who took assessments in English and Spanish across time points.

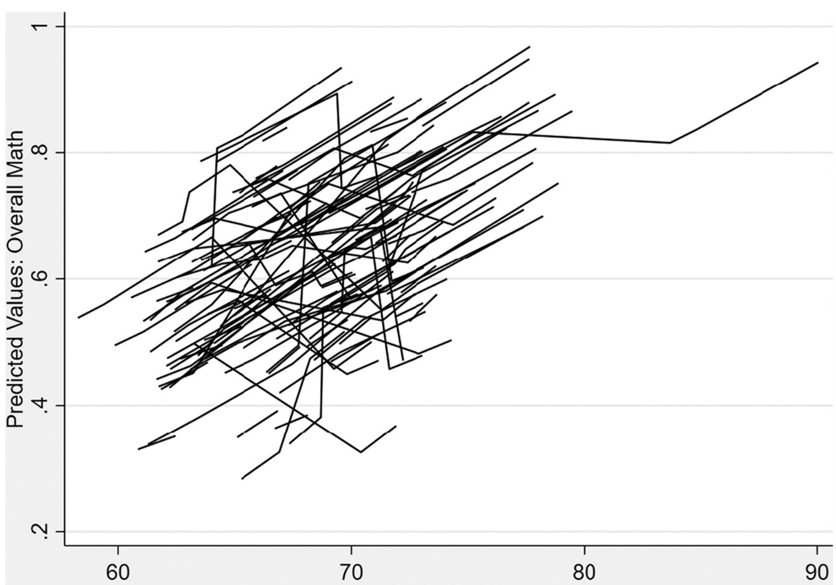

Fig. 1. Growth trajectories for math.

Robustness to inclusion of only cohort 1

Given that COVID-19 prevented us from collecting cohort 2's data (n = 96) at the third time point (spring), it was possible that the results obtained here were driven by data artifacts related to cohort 2's absence at the third time point. Thus, we re-ran analyses using only cohort 1 (n = 55). The results of these analyses are available in the Online Supplementary Material (Table S3). Overall, we found that our results were consistent (both in magnitude and significance) to results presented above.

Discussion

The study examined relations among kindergarteners' ATL, home numeracy practices, and their growth in math skills among a sample of Latino families from low-SES households. We found positive and significant linear growth in Latino kindergarteners' math skills. In addition, we found that Latino kindergarteners' ATL positively related to variation in initial math skills, but frequency of home numeracy practices did not. We elaborate on these findings below.

The first key finding was that Latino children made significant progress in their math skills during the kindergarten year. This is a noteworthy finding, given that growth in math skills is a better predictor of math achievement in elementary and middle-school than school-entry skills (Claessens et al., 2009; Jordan et al., 2006, 2009). Our findings are aligned with prior research showing that Latino kindergarteners improve their math skills substantially during the year (Murphey et al., 2017). However, it is important to note that we cannot directly compare our results with those of prior literature because the math measures used by prior studies are quite different than the ones we used here (e.g., prior work has included patterning and spatial reasoning), and because no other study has modeled growth (and not simply gains) in Latino kindergarteners' math skills.

While we found positive and significant linear growth in math skills, we found negligible variability in the trajectories of slopes. This might be due to a relatively small sample size, to the periodicity of time points (e.g., all within the same grade) or the fact that we focused only on basic math skills (e.g., one-to-one correspondence, number identification, adding and subtracting). Longitudinal work by Jordan et al. (2009) conducted on samples from low- and middle-SES found significant variability when measuring various basic and advanced math outcomes from kindergarten to hird grade (up to 11 time points) a standardized battery of tests. In future work, it would be important to examine advanced math skills (e.g., number line) during this important transitional year and include other math dimensions such as patterning, which are foundational for later math achievement (Milburn, Lonigan, De Florio, & Klein, 2019). In addition, it will also be important to consider the addition of time points that extend to early formal schooling. These two extensions would add to our understanding of Latino children's math development.

A second key finding was that Latino children who started kindergarten with strong ATL skills, thus displaying high levels of engagement, motivation, and persistence in learning activities (at least in the context of this assessment), were more likely to have better math skills initially. The size of the association was medium (0.41 *SD*) and greater than that reported by prior work (0.29 *SD*; Galindo & Fuller, 2010). The difference in magnitude between Galindo and Fuller (2010) and our study could be attributed to differences in the number and content of items and range in scores of the math assessments administered. Caution should be exercised when interpreting size of associations based on standardized regression coefficients because they are sensitive to the assessment used and its variability (Willett, Singer, & Martin, 1998).

This finding adds to an emerging body of evidence highlighting the unique role that Latino children's ATL plays in math achievement (Bustamante & Hindman, 2020; Galindo & Fuller, 2010). Latino children are socialized into developing ATL skills early on in life because having those skills allow children to enact the sociocultural values of respect, *buena educación*, and *familismo* (García Coll & Pachter, 2002; Valdés, 1996). Furthermore, Latino children's ATL might act as a protective factor against the negative effects of several social and structural factors they experience (e.g., poverty, racial discrimination, and segregation; García-Coll et al., 1996; McWayne, Green, & Fantuzzo, 2009). The two prior studies documenting associations between ATL and math have used teacher ratings to assess ATL (Bustamante & Hindman, 2020; Galindo & Fuller, 2010). Here we used assessor ratings which might be, on the one hand less "biased" (less prone to be influenced by specific experiences teachers had with children), but on the other hand, rely on a shorter time of interaction with the child in a specific testing context. Our findings may suggest that regardless of the method used to assess ATL, consistent associations between this set of competencies and math achievement are found among Latino children.

The third key finding was that the frequency with which parents reported engaging in home numeracy practices (i.e., teaching numbers, counting, and comparing) did not relate to children's math skills at kindergarten entry, aligning with prior work conducted with Latino preschoolers in the U.S. (De Florio & Beliakoff, 2015; Kung et al., 2021; Missall et al., 2015) and in low-SES families in Mexico (Susperreguy et al., 2021). Null associations of home practices to Latino children's growth in other domains (literacy) has been documented by others (Yeomans-Maldonado et al., 2021). However, none of these prior studies focused on kindergarteners.

It is possible that we did not find associations between home numeracy practices and kindergarteners' math skills because we focused on the frequency rather than on the depth (or complexity) of such home practices. Not all numeracy practices are equal; some might be more conducive to foster math understanding than others. Recent work suggests the important role that the complexity of parent-child math talk, and not simply sheer amount, plays in math development (Uscianowski, Almeda, & Gisnburg, 2020). Alternatively, it is also possible that we did not find associations because we did not factor in the role of parents' math anxiety. A recent study of parents and children from low-SES and ethnically diverse backgrounds in the U.S. showed no overall associations between frequency of home numeracy practices and children's math skills but moderation effects by levels of parental math anxiety. Frequency of home numeracy related to children's math skills but only when parents' math anxiety levels were low (Cosso et al., 2022).

The lack of associations between home numeracy practices and math outcomes is likely not due to low levels of parental engagement in home practices. Almost 25% of Latino parents reported engaging in numeracy practices at home 5 to 7 times per week, and another 47% reported engaging in such practices between 3 and 5 times per week. Thus, the null associations were not due to lack of variability or floor effects on parental reports of home numeracy practices. Overall, our findings challenge ideas that Latino parents seldom engage in home numeracy practices. Like Galindo et al. (2019), we found that parents engage in math teaching on a regular basis at home. Future studies should collect data using other methodologies such as time diaries or direct observations of parent-child interactions to better understand home numeracy practices in Latino communities (Bachman et al., 2020).

In addition, the lack of associations between home math practices and math outcomes is likely not due to the small number of items included in the home numeracy survey ($n = 3$). While some studies have included as few as 3–5 items and found positive relations to children's math skills (Kleemans, Peeters, Segers, & Verhoeven, 2012; Manolitsis, Georgiou, & Tziraki, 2013; Niklas & Schneider, 2014), others have included as many as 36 items and found no associations (De Florio & Beliakoff, 2015; De Keyser et al., 2020; Missall et al., 2015). Hence, the number of survey items seems to be unrelated to whether or not associations are present (Leyva, Libertus, & McGregor, 2021).

Limitations

There are several important limitations of our study. First, our sample involved primarily recent immigrant families from Latin America (particularly from Mexico and Central American countries) from low-SES households living in the Southeastern United States. Caution should be exercised when generalizing these results to other Latino communities within the U.S., given the wide variability in practices, values, and beliefs within and across Latino communities (Prevoo & Tamis-LeMonda, 2017). Second, children's ATL was assessed by research assistants within the context of an independent assessment of academic and social skills, using seven items taken from the IDELA based on a 4-point scale. Though others have used similar numbers of items to assess ATL (e.g., Bustamante & Hindman, 2020; Galindo & Fuller, 2010), future studies should consider using more comprehensive ATL measures such as the Learning-to-Learn Scales (McDermott et al., 2011) and other sources of information, for example teacher reports of children's ATL within the context of the classroom, to have a better understanding of children's ATL.

Third, we focused on a measure of the three common direct (formal) numeracy activities (teaching numbers, counting, and comparing quantities) but did not include measures of indirect (or informal) numeracy activities (Hornburg, Boriello, Kung, Lin, & Litkowski, et al., 2021). Exploring parental math support in daily activities (informal numeracy activities such as household chores) might increase understanding of the relations between frequency of home numeracy practices and math growth. As others have noted, participation in these daily activities offers children critical opportunities to learn and develop, understand their role in their community, and embrace the values, traditions and beliefs that are unique to their community (Rogoff et al., 2007). Also, home numeracy practices were assessed at the beginning of the kindergarten year. It is possible that such practices changed (increased) during the kindergarten year because of classroom instruction and parents' awareness of and willingness to help with children's homework. In addition, our study is correlational and not causal; findings need replication in larger samples with more rigorous designs. Finally, it is unclear whether parents' responses to the study's home numeracy practices survey relate to actual behaviors in real-world settings. In the future, collecting and comparing different sources of home numeracy practices information (e.g., observations of parent-child interactions, time diaries) might be important to comprehensively assess parental support of math skills at home (Bachman et al., 2020).

Last, some of the covariates included in the model had high levels of missing data. Although results were robust to accounting for missing data using two different approaches (i.e., multiple imputation and replacing missing data with a constant combined with the inclusion of a missing data indicator), we cannot rule out with full certainty any potential bias that could have been introduced due to missing data.

Conclusion

Our correlational results – if replicated in larger samples and with more rigorous study designs – suggest possible avenues to promote math skills might include public investment and programing supporting efforts to help kindergarten teachers design classroom activities that leverage Latino's strong ATL skills at school entry, raising teachers' awareness of what Latino children already know and can do with math at school entry.

Declaration of Competing Interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appdev.2022.101417.

References

Bachman, H., Elliott, L., Duogn, S., Betancur, L., Navarro, M., Votruba-Drzal, E., & Libertus, M. (2020). Triangulating multi-method asessments of parental support for early math skills. *Frontiers of Education, 5*, 1–18. https://doi.org/10.3389/feduc.2020.589514

Best, J., Miller, P., & Naglieri, J. (2011). Relations between executive function and academic achievement from ages 5 to 17 in a large, representative national sample. *Learning and Individual Differences, 21*, 327–336. https://doi.org/10.1016/j.lindif.2011.01.007

Bjorklund, D. F., Hubertz, M. J., & Reubens, A. C. (2004). Young children's arithmetic strategies in social context: How parents contribute to children's strategy development while playing games. *International Journal of Behavioral Development, 28*, 347–357. https://doi.org/10.1080/01650250444000027

Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology, 20*, 899–911. https://doi.org/10.1017/S0954579408000436

Bulotsky-Shearer, R. J., López, L. M., & Mendez, J. L. (2015). The validity of interactive peer play competencies for Latino preschool children from low-income households. *Early Childhood Research Quarterly, 34*, 78–91. https://doi.org/10.1016/j.ecresq.2015.09.002

Bustamante, A. S., & Hindman, A. H. (2020). Construyendo en la Fuerza: Approaches to learning and school readiness gains in Latino children served by head start. *Early Childhood Research Quarterly, 52*, 124–137. https://doi.org/10.1016/j.ecresq.2018.06.003

Civil, M., & Andrade, R. (2002). Transitions between home and school mathematics: Rays of hope amidst the passing clouds. In G. de Abreu, A. J. Bishop, & N. C. Presmeg (Eds.), *Transitions Between Contexts of Mathematical Practices* (pp. 149–169). Boston, MA: Kluwer.

Claessens, A., Duncan, G., & Engel, M. (2009). Kindergarten skills and fifth-grade achievement: Evidence from the ECLS-K. *Economics of Education Review, 28*, 415–427. https://doi.org/10.01016/j.econedurev.2008.09.003

Coolahan, K. C., Fantuzzo, J., Mendez, J., & McDermott, P. (2000). Preschool peer interactions and readiness to learn: Relationships between classroom peer play and learning behaviors and conduct. *Journal of Educational Psychology, 92*, 458–465. https://doi.org/10.1037/0022-0663.92.3.458

Cosso, J., Ellis, A., O'Rear, C., Zippert, E., Schmitt, S., & Purpura, D. (2022). Conceptualizing the factor structure of parents' math anxiety and associations with children's mathematics skills. *Annals of the New York Academy of Science*, 1–14. https://doi.org/10.1111/nyas.14736

Crosnoe, R. (2007). Early child care and the school readiness of children from Mexican Immigrant Families. *International Migration Review, 41*, 152–181. https://doi.org/10.1111/j.1747-7379.2007.00060.x

De Florio, L., & Beliakoff, A. (2015). Socioeconomic status and preschoolers' mathematical knowledge: The contribution of home activities and parent beliefs. *Early Education and Development, 26*, 319–341. https://doi.org/10.1080/10409289.2015.968239

De Keyser, L., Bakker, M., Rath, S., Wijns, N., Torbeyns, J., Verschaffel, L., & De Smedt, B. (2020). No association between the home math environment and numerical and patterning skills in a large and diverse sample of 5- to 6-year-olds. *Frontiers in Psychology, 11*, 1–13. https://doi.org/10.3389/fpsyg.2020.547626

Duncan, G., Dowsett, C., Claessens, A., Magnuson, K., Huston, A., … Duckworth, K. (2007). School readiness and later achievement. *Developmental Psychology, 43*, 1428–1446. https://doi.org/10.1037/0012-1649.43.6.1428

Eason, S., Scalise, N., Berkowitz, T., Ramani, G., & Levine, S. (2020). Reviewing the Family Math Literature. Recommendations for Practice, Policy, and Research. Available at https://education-first.com/wp-content/uploads/2020/06/FamilyMathReview_WhitePaper.pdf.

Engel, M., Claessens, A., & Finch, M. (2013). Teaching students what they already know? The (mis)alignment between mathematics instructional content and student knowledge in kindergarten. *Educational Evaluation and Policy Analysis, 35*, 157–178. https://doi.org/10.3102/0162373712461850

Galindo, C., & Fuller, B. (2010). The social competence of Latino kindergarteners and growth in mathematical understanding. *Developmental Psychology, 46*, 579–592. https://doi.org/10.1037/a0017821

Galindo, C., Sonnenschein, S., & Montoya-Ávila, A. (2019). Latina mothers' engagement in children's math learning in the early school years: Conceptions of math and socialization practices. *Early Childhood Research Quarterly, 47*, 271–283. https://doi.org/10.1016/j.ecresq.2018.11.007

García Coll, C., & Pachter, L. M. (2002). Ethnic and minority parenting. In M. H. Bornstein (Ed.), *Handbook of Parenting: Vol. 4. Social Conditions and Applied Parenting* (2nd ed., pp. 1–20). Mahwah, NJ: Erlbaum.

García-Coll, C., Lamberty, G., Jenkins, R., McAdoo, H. P., Crnic, K., Wasik, B. H., & García, H. V. (1996). An integrative model for the study of developmental competencies in minority children. *Child Development, 67*, 1891–1914. https://doi.org/10.1111/j.1467-8624.1996.tb01834.x

Gennetian, L., Cabrera, N., Crosby, D., Guzman, L., Smith, J., & Wildsmith, E. (2021). A strength-based framework for realizing Latino young children's potential. *Policy Insights From the Behavioral and Brain Sciences, 8*, 152–159. https://doi.org/10.1177/23727322211033618

Gonzalez, N., Andrade, R., Civil, M., & Moll, L. (2001). Bridging funds of distributed knowledge: Creating zones of practices in mathematics. *Journal of Education for Students Placed at Risk, 6*, 115–132. https://doi.org/10.1207/S15327671ESPR0601-2_7

Hornburg, C., Boriello, J., Kung, M., Lin, J., Litkowski, E., et al. (2021). New directions in measurement of the home mathematics environment: An international and interdisciplinary perspective. *Journal of Numerical Cognition., 7*, 195–220. https://doi.org/10.5964/jnc.6143

Howes, C., & Wishard Guerra, A. (2009). Building vocabulary in two languages: An examination of Spanish-speaking Dual Language Learners in Head Start. *Early Childhood Research Quarterly, 31*, 19–33. https://doi.org/10.1016/j.1467-9507-2008.00524.x

Howse, R., Lange, G., Farran, D., & Boyles, D. (2003). Motivation and self-regulation as predictors of achievement in economically disadvantaged young children. *Journal of Experimental Education, 71*, 151–174. https://doi.org/10.1080/0020970309602061

Jordan, N., Kaplan, D., Olah, L., & Locuniak, M. (2006). Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties. *Child Development, 77*, 153–175. https://doi.org/10.1111/j/1467-8524.2006.00862.x

Jordan, N., Kaplan, D., Ramineni, C., & Locuniak, M. (2009). Early math matters: Kindergarten number competence and later mathematics outcomes. *Developmental Psychology, 45*, 850–867. https://doi.org/10.1037/a0014939

Kleemans, T., Peeters, M., Segers, E., & Verhoeven, L. (2012). Child and home predictors of Early numeracy skills in kindergarten. *Early Childhood Research Quarterly, 27*, 471–477. https://doi.org/10.1016/j.ecresq.2011.12004

Kung, M., Stolz, K., Lin, J., Foster, M., Schmitt, S., & Purpura, D. (2021). The home numeracy environment and measurement of numeracy performance in English and Spanish in Dual Language Learners. *Topics in Early Childhood Secial Education, 40*, 241–252. https://doi.org/10.1177/0271121420942588

La Paro, K. M., & Pianta, R. C. (2000). Teachers' reported transition practices for children transitioning into kindergarten and first grade. *Exceptional Children, 67*, 7–20.

Leyva, D., Libertus, M., & McGregor, R. (2021). Relations between subdomains of home math activities and corresponding math skills in 4-year-old children. *Education Sciences, 11*, 594–609. https://doi.org/10.3390/edusci11100594

Leyva, D., Shapiro, A., Yeomans-Maldonado, G., Weiland, C., & Leech, K. (2022). Positive impacts of a strengths-based family program on Latino kindergarteners' narrative language abilities. Available at: *https://pubmed.ncbi.nlm.nih.gov/35298191/* doi: 10.1037/dev0001332.

Leyva, D., Weiland, C., Shapiro, A., Yeomans-Maldonado, G., & Febles, A. (2021). A Strengths-Based, Culturally Responsive Family Intervention Improves Latino Kindergarteners' Vocabulary and Approaches to Learning. *Child Development, 93*, 451–467. https://doi.org/10.1111/cdev.13698

López, C., & Donovan, L. (2009). Involving Latino parents with mathematics through family math nights. *Journal of Latinos and Education, 8*, 219–230. https://doi.org/10.1080/15348430902888666

Manolitsis, G., Georgiou, G., & Tziraki, N. (2013). Examining the effects of home literacy and numeracy environment on early reading and math acquisition. *Early Childhood Research Quarterly, 28*, 692–703. https://doi.org/10.1016/j.ecresq.2013.04.004

McClelland, M., Morrison, F., & Holmes, D. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Childhood Research Quarterly, 15*, 307–329. https://doi.org/10.1016/S0885-2006(00)00069-7

McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. *Early Childhood Research Quarterly, 21*, 471–490. https://doi.org/10.1016/j.ecresq.2006.09.003

McDermott, P. A., Fantuzzo, J. W., Warley, H. P., Waterman, C., Angelo, L. E., Gadsden, V. L., & Sekino, Y. (2011). Multidimensionality of teachers' graded responses for preschoolers' stylistic learning behavior: The Learning-to-Learn Scales. *Educational and Psychological Measurement, 71*, 148–169. https://doi.org/10.1177/0013164410387351

McDermott, P. A., Rikoon, S. H., & Fantuzzo, J. W. (2014). Tracing children's approaches to learning through head start, kindergarten, and first grade: Different pathways to different outcomes. *Journal of Educational Psychology, 106*(1), 200–213. https://doi.org/10.1037/a0033547

McWayne, C., Green, L., & Fantuzzo, J. (2009). A variable- and person-oriented investigation of preschool competencies and Head Start children's transition to kindergarten and first grade. *Applied Developmental Science, 13*, 1–15. https://doi.org/10.1080/10888690802606719

Milburn, T., Lonigan, C., De Florio, L., & Klein, A. (2019). Dimensionality of preschoolers' informal mathematical abilities. *Early Childhood Research Quarterly, 47*, 487–495. https://doi.org/10.1016/j.ecresq.2018.07.006

Missall, K., Hojnoski, R., Caskie, G., & Repasky, P. (2015). Home numeracy environments of preschoolers: Examining relations among mathematical activities, parent mathematical beliefs, and early mathematical skills. *Early Education and Development, 26*, 356–376. https://doi.org/10.1080/10409289.2015.968243

Murphey, D., Madill, R., & Guzman, L. (2017). Making math count more for young Latino children. In *Child Trends, Publication # 2017–02*. Available at: http://www.childtrends.org/wp-content/uploads/2017/02/Early-Math-Report-2.8.pdf.

Niklas, F., & Schneider, W. (2014). Casting the die before the die is cast: The importance of the home numeracy environment for preschool children. *European Journal of Psychology of Education, 29*, 327–345. https://doi.org/10.1007/s10212-013-0201-6

Perez-Brena, N. J., Rivas-Drake, D., Toomey, R. B., & Umaña-Taylor, A. J. (2018). Contributions of the integrative model for the study of developmental competencies in minority children: What have we learned about adaptive culture? *American Psychologist, 73*, 713–726. https://doi.org/10.1037/amp0000292

Pew Research Center. (2020). About one-in-four U.S. Hispanics have heard of Latinx, but just 3% use it. Available at https://www.pewresearch.org/hispanic/2020/08/11/about-one-in-four-u-s-hispanics-have-heard-of-latinx-but-just-3-use-it/.

Pisani, L., Borisova, I., & Dowd, A. (2018). Developing and validating the International Development and Early Learning Assessment (IDELA). *International Journal of Educational Research, 91*, 1–15. https://doi.org/10.1016/j.ijer.2018.06.007

Pisani, L., Borisova, I., & Dowd, A. J. (2015). International development and early learning assessment technical working paper. In *Save the Children*. Available at http://repositorio.minedu.gob.pe/handle/20.500.12799/4344.

Prevoo, M., & Tamis-LeMonda, C. (2017). Parenting and globalization in western countries: Explaining differences in parent-child interactions. *Current Opinion in Psychology, 15*, 33–39. https://doi.org/10.1016/j.copsic.2013

Reardon, S., & Portilla, X. (2016). Recent trends in income, racial, and ethnic school readiness gaps at kindergarten entry. *AERA, 2*, 1–18. https://doi.org/10.1177/2332858416657343

del Río, M., Susperreguy, M., Strasser, K., & Salinas, V. (2017). Distinct influences of mothers and fathers on kindergarteners' numeracy performance: The role of math anxiety, home numeracy practices and numeracy expectations. *Early Education and Development, 28*, 939–955. https://doi.org/10.1080/10409289.2017.1331662

Rogoff, B., Moore, L., Najafi, B., Dexter, A., Correa-Chávez, M., & Solís, J. (2007). Children's development of cultural repertoires through participation in everyday routines and practices. In J. Grusec, & P. Hastings (Eds.), *Handbook of Socialization: Theory and Research* (pp. 490–515). New York, NY: Guilford Press.

Salinas, C. (2020). The complexity of the "x" in Latinx: How Latinx/a/o students relate to, identify with, and understand the term Latinx. *Journal of Hispanic Higher Education, 19*, 149–168. https://doi.org/10.1177/1538192719900382

Save the Children. (2017). International Development and Early Learning Assessment (IDELA). Overview of assessment available at https://idela-network.org/the-idela-tool/. Technical manual available at https://idela-network.org/community-of-practice/topic/how-to-calculate-scores-for-the-four-idela-domains/.

Siegler, R. S., Thompson, C. A., & Schneider, M. (2011). An integrated theory of whole number and fractions development. *Cognitive Psychology, 62*, 273–296. https://doi.org/10.1016/j.cogpsych.2011.03.001

Singer, J., & Willett, J. (2003). *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. Oxford, UK: Oxford University Press.

Suárez-Orozco, C., Suárez-Orozco, M., & Todorova, I. (2008). *Learning a new land: Immigrant students in American society*. Cambridge, MA: Harvard University Press.

Susperreguy, M., Burr, S., Xu, C., Douglas, H., & LeFevre, J. (2020). Children's home numeracy environment predicts growth of their early mathematical skills in kindergarten. *Child Development, 91*, 1663–1680. https://doi.org/10.1111/cdev.13353

Susperreguy, M., Jiménez Lira, C., Xu, C., LeFevre, J., Vega, H., Pando, E., & Contreras, M. (2021). Home learning environments of children in Mexico in relation to socioeconomic status. *Frontiers in Psychology, 12*, Article 626159. https://doi.org/10.3389/fpsyg.2021/626159

US Census Bureau. (2019). Quick facts. In *Hispanic or Latino. Population Estimates July 1, 2019*. Available at: https://www.census.gov/quickfacts/fact/table/US.

Uscianowski, C., Almeda, M., & Gisnburg, H. (2020). The complexity of math and literacy questions parents pose during book reading. *Early Childhood Research Quarterly, 50*, 20–50. https://doi.org/10.1016/j.ecresq.2018.07.003

Valdés, G. (1996). *Con respeto: Bridging the distances between culturally diverse families and schools. An ethnographic portrait*. New York: Teachers College Press.

Watts, T., Duncan, G., Siegler, R., & Davis-Kean, P. (2014). What's past is prologue: Relations between early mathematics knowledge and high school achievement. *Educational Researcher, 43*, 352–360. https://doi.org/10.3102/0013289X14553660

West, S., Finch, J., & Curran, P. (1995). Structural equation models with nonnormal variables: Problems and remedies. In R. H. Hoyle (Ed.), *Structural Equation Modeling: Concepts, Issues, and Applications* (pp. 56–75). New York: Sage.

What Works Clearinghouse Standards. (2017). What Works Clearinghouse. Retrieved from: https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_standards_handbook_v4.pdf.

Willett, J., Singer, J., & Martin, N. (1998). The design and analysis of longitudinal studies of developmental and psychopathology in context: Statistical models and methodological implications. *Development and Psychopathology, 10*, 395–426. https://doi.org/10.1017/S0954579498001667

Wolf, S., Halpin, P., Yoshikawa, H., Dowd, A. J., Pisani, L., & Borisova, I. (2017). Measuring school readiness globally: Assessing the construct validity and measurement invariance of the International Development and Early Learning Assessment (IDELA) in Ethiopia. *Early Childhood Research Quarterly, 41*, 21–36. https://doi.org/10.1016/j.ecresq.2017.05.001

Wolf, S., & Suntheimer, N. M. (2020). Predictors of parental disciplinary practices and associations with child outcomes among Ghanaian preschoolers. *Children and Youth Services Review, 112*. https://doi.org/10.1016/j.childyouth.2019.104518

Yen, C., Konold, T., & McDermott, P. (2004). Does learning behavior augment cognitive ability as an indicator of academic achievement? *Journal of School Psychology, 42*, 157–169. https://doi.org/10.1016/j.jsp.2003.12.001

Yeomans-Maldonado, G., Mesa, C., & LAARC. (2021). The association of the home literacy environment and parental reading beliefs with oral language growth trajectories of Spanish-English bilingual children. *Early Childhood Research Quarterly, 57*, 271–284.

Yosso, T. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race, Ethnicity and Education, 8*, 69–91. https://doi.org/10.1080/1361332052000341006