TeachME PROFESSIONAL DEVELOPMENT

CEU's for Teachers and Educators

Making Math Count for Young Latino Learners

Executive Summary

National and international data paint a discouraging picture of math proficiency in the United States.[1] The 21st century economy will increasingly be one in which those proficient in STEM (science, technology, engineering, and math) skills will have an advantage with employers, as well as in navigating the technology-related tasks of everyday life.[2] Children's ability in mathematics, which builds on what young children have learned in their early years, is critical to their success in school, and to their future economic success.

One in four U.S. kindergarteners today is Latino.[a,3] In California and New Mexico, Latino children are already in the majority.[4] How this group fares in school, and how well prepared they are for the needs of an economy that is increasingly technology-based, will have far-reaching implications for our country. For that reason alone, notwithstanding concerns about equity, their math skills deserve a special focus. Achievement gaps (in math as well as in reading) between Latino children and their white counterparts emerge early in life, and can have negative effects that extend over the school years and beyond.[5]

For this report, we reviewed existing research and conducted an original analysis of data from a large, nationally representative sample of Latino kindergartners, with the aim of understanding what factors are associated with math achievement prior to and during the kindergarten year.

Here is what we found to be the case at the start of kindergarten:

- Latino children's math skills trail those of white children by the equivalent of 3 months' learning.
- Latino children are more than twice as likely as white children to be poor,[6] and much of the variation in Latino children's math scores can be explained by poverty. Being from a low-income family, having parents with no education beyond high school, and living in a household where English is not the primary language spoken, are all associated with lower math scores for Latino children starting kindergarten. The specific mechanisms underlying these relationships need further exploration.
- Having prior experience in center-based child care,[7] more children's books at home, and parents who frequently practice numbers with them, are all independently associated with *higher* math achievement for Latino children starting kindergarten.

Here is what we found to be the case over the kindergarten year:

- Latino children's progress in math achievement is helped by their attending a full-day kindergarten, and—as we found at kindergarten entry—by having more children's books at home.
- After accounting for poverty, Latino and white children learn math at the same rate during kindergarten. But because, as a group, Latino children start behind their white peers, they remain behind in math by the spring of the kindergarten year.
- Among Latino children who started the year with relatively weak math skills, those with strong executive functioning made the greatest progress. Executive functioning skills, such as paying attention and self-control, underlie multiple areas of academic achievement and social-emotional development. executive functioning made the greatest progress. Executive functioning skills, such as paying attention and self-control, underlie multiple areas of academic achievement and social-emotional development.

Expanding on our own findings, the broader research literature identifies some systemic barriers to improving children's math skills, including those of Latino children. For example, the research literature points to widespread, but faulty, beliefs that math ability is largely innate,[8] to anxieties associated with math performance,[9] and to bias against minority

[a] In this report, we use *Latino* to refer to the group that is also termed *Hispanic*.

students[10]—all of which can impede children's progress. Classroom instruction in math is often inadequate or not focused so as to be most effective.[11]

Our recommendations stem from our study findings, as well as our literature review, which identified opportunities for multiple stakeholder groups. We provide more detail on the basis for our recommendations in the full report. They include:

Policymakers

- Broaden access to high-quality early care and education, and make it more responsive to the needs of Latino families with young children.
- Make full-day kindergarten available to all families, regardless of where they live.
- Adopt common standards for early math achievement.

Organizations engaged in education and advocacy

- Use multiple forms of communication (e.g., videos, social media, personal contact) to help correct prevalent misunderstandings and anxieties about math, and to offer practical help to parents, teachers, and others on encouraging children's early math skills.
- Expand the reach of programs that make children's books freely available.

The education community

- Increase the supply and strengthen the preparation of teachers who can provide high-quality early math learning experiences.
- Give greater attention to the special needs and strengths of dual language learners and their families.
- Improve the quantity and quality of developmentally appropriate mathematics instruction, including using a structured curriculum.
- Incorporate activities that promote children's social-emotional learning and executive function.
- Adapt instruction, linguistically and in other ways, so it is congruent with students' cultural backgrounds.
- Examine both explicit and implicit biases that may restrict children's math learning.
- Help sustain the engagement of parents and other family members in children's learning, at school and at home.

Parents

- Talk about math-related questions or tasks with children—using the language you are most comfortable with.
- Make math fun by capitalizing on, or creating, opportunities to bring number concepts and related language into children's play.
- Play games with children that may reinforce their emerging executive function skills.
- Introduce a variety of activities that are rich in language and content about the wider world.
- Build a collection of children's books, including those freely available or borrowed from a library.

Researchers

- Further investigate the development of early math skills, particularly through studies that delve deeply into the diverse Latino experience (e.g., differences in primary language used; country of origin).
- Develop valid assessments of early skills (both academic and non-academic) for Latino children, and for others from non-dominant cultural backgrounds.
- Further investigate the potential role of bias in teachers' ratings of children's skills, their expectations for children's behavior, and their interactions with students.

Overview

Gaining a solid grasp of mathematics is among one of the most important academic skills young children can accomplish, providing the basis for much of their subsequent cognition and learning.[12]

The early development of children's math skills is also interdependent with other cognitive, social, and emotional competencies that emerge during early childhood.[13] These interconnections highlight multiple entry-points for policymakers, teachers, parents, and others to promote early math learning.

Considering its critical role as a foundation for work in the sciences as well as for many aspects of everyday life, the generally poor level of mathematics knowledge in the United States is alarming.[14] Persistent achievement gaps associated with race/ethnicity and income are further reasons for concern.[15]

In this report, we review the existing literature on the early development of math skills, with a particular focus on Latino[b] children. In addition, we share findings from our original analysis of the Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011, a nationally representative data set that follows students starting in their kindergarten year.

We begin by providing an overview of the research on the importance, starting in early childhood, of mathematics knowledge. We then look at predictors of children's math scores at the start of the kindergarten year, and at predictors of their growth between the beginning and end of kindergarten. Finally, we offer to the diverse groups who have a stake in this issue—policymakers, professional associations and advocacy organizations, educators, and parents—a number of specific recommendations to support early math skill development.

Early Math and Latino Children

The importance of early math learning for all children

Mathematics proficiency in the United States is at an alarmingly low level. Just one third of eighth-graders reach the "proficient or better" level on a national assessment.[16] On an international assessment of numeracy,[c] the United States, in 2012, ranked below 18 other countries. On an international assessment of problem-solving in technology-rich environments,[d] 14 countries scored ahead of the United States.[17] It will be difficult for our nation to remain competitive

[b] In this report, we use *Latino* to refer to the group also termed *Hispanic*.

[c] Defined as "the ability to access, use, interpret, and communicate mathematical information and ideas, to engage in and manage mathematical demands of a range of situations in adult life." Goodman, M., Finnegan, R., Mohadjer, L., Krenzke, T., and Hogan, J. (2013). *Literacy, numeracy, and problem solving in technology-rich environments among U.S. adults: Results from the Program for the International Assessment of Adult Competencies 2012: First Look (NCES 2014-008).* U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved from https://nces.ed.gov/pubs2014/2014008.pdf, p. 2.

[d] "Using digital technology, communication tools, and networks to acquire and evaluate information, communicate with others, and perform practical tasks." Ibid, p. 2.

in the modern economy, unless we effectively increase our collective proficiency with skills related to science, technology, engineering, and math (STEM).

Early childhood is the logical place to start.[18] Children as young as 6 months of age have rudimentary math skills. These begin with the ability to recognize numbers and shapes, and compare relative sizes. Counting and sequencing abilities are followed by skills in addition and subtraction.[19] Given the right supports, young children can learn a variety of mathematical concepts by building on their intuitive understandings and informal experiences.[20]

Children's early math skills (particularly number system knowledge) are highly predictive of future math understanding.[21] Both math ability at preschool and growth in math skills during preschool and kindergarten strongly predict math achievement in high school.[22] But the importance of early math ability extends even further. Children's early math skills are a better predictor than early reading skills of later academic success.[23] Knowledge of math at age 7 predicts socio-economic status at age 42, even more strongly than family socio-economic status at age 7 does.[24] Yet early math skills are seldom given the attention that early literacy receives.[25]

For all young children, the development of math skills is closely linked with the development of literacy skills, and with other important non-academic abilities.

Early mathematics learning is associated with the development of skills and dispositions that support multiple areas of learning and cognitive ability. Thus, there are many avenues (not all of which have to do explicitly with math) through which parents, teachers, and others can help develop children's early math skills.

Early childhood experts are increasingly finding that the skills young children need to be ready for school, and to succeed academically, are multi-dimensional and interdependent. Particularly in the early years, when their brains and bodies are growing at astounding rates, children's development is not easily partitioned into discrete categories of skills, but is more inclined to proceed in ways that are both holistic and inter-connected.[26]

For example, as any preschool teacher knows, in order to learn effectively, children need a degree of self-control, some ability to get along with others, an attitude of interest or curiosity, and to be reasonably well-fed, rested, and otherwise healthy.[27] Thus, while researchers and practitioners may separate, for purposes of discussion, children's general knowledge, approaches to learning, social-emotional skills, or physical health, in reality all of these are necessary, and intertwined, components of development.[28] This implies that efforts to boost young children's skills in math, in fact, need to draw from a broad palette.

Indeed, this is what a number of studies show. For example, children (including Latino children) who started kindergarten more prepared in math made greater progress over the year than those who were less well prepared in math. However, parents' reading with their children at home was also associated with higher math scores by the spring of the year.[29] Likewise, another study found that Latino children's early literacy predicted their elementary school math achievement.[30]

In addition, certain *general skills* underlie a broad range of competencies, including in math. A set of attitudes or dispositions commonly referred to as *approaches to learning* are critical to young children's readiness for school.[31] These characteristics (as measured at the beginning of kindergarten)—including attention, persistence, eagerness to learn, independence, and adaptability—are associated with higher cognitive achievement, including in math, over the first 3 years of school.[32] Children with positive approaches to learning make greater *gains* over these 3 years; the effect is greatest among children living in low-income households.[33] In another study, attention skills at age 4 predict math and reading achievement at age 21, even after accounting for achievement levels at age 7, as well as for a number of other variables. These skills also predict the likelihood of completing college by age 25.[34]

Connections apparently work both ways: researchers also find that children's early math and reading skills are predictive of their approaches to learning, as measured in fifth grade.[35]

Young children's social skills also associated with their school achievement. Poor *social-behavioral skills*, as early as kindergarten, are associated with worse academic outcomes in third grade, such as repeating a grade, receiving special education services, and being suspended or expelled.[36] One longitudinal study found that kindergartners who more frequently shared, cooperated, and engaged in helpful behaviors were more likely to be successful as young adults; in contrast, those with poorer social skills were more likely to drop out of high school, abuse drugs or alcohol, and be dependent on government assistance.[37]

Studies that explore these concepts specifically with Latino students are rare, and have produced mixed findings.[38,39] Moreover, researchers question whether commonly-used measures are valid for assessing social competence among children from non-dominant cultural backgrounds.[40]

Often, social skills are linked with another fundamental set of abilities, termed *executive functioning* or *self-regulation*. *Executive function* skills encompass *working memory* (retaining information and being able to apply it), *inhibitory control* (the ability to resist impulses or distractions and focus on what is most important), and *cognitive flexibility* (the ability to adapt to changing perspectives, priorities, and demands).[41] *Self-regulation* (which draws upon these executive function skills) is a strong predictor of children's positive adjustment to school and good relationships with teachers and peers, which, in turn, are associated with better academic performance.[42]

There is solid evidence that executive function facilitates mathematics learning, *and* that high-quality mathematics instruction may help to develop young children's executive functioning.[43]

Today's young Latino learners will be leading a "majority-minority" nation as adults.

Current disparities in educational achievement, including in math, make for a disturbing scenario when we consider the needs of the next-generation economy.[44] As "minorities" (that is, children who are Latino or non-white) become the majority within the next few years, achievement gaps will no longer be issues solely of equity and justice, but will threaten our nation's ability to maintain our position as a global leader.

For complex reasons, many Latino children and youth lag behind their white peers when it comes to school readiness, K-12 academic achievement, and high school and post-secondary completion. These disparities begin early in life. For example,

- in 2012, 57 percent of Latino children ages 3 to 6 could count to 20 (in English or Spanish)—one of several kindergarten readiness skills—compared with nearly three quarters of white children;[45]
- at fourth grade, the percentage of non-Latino white students scoring at "proficient or above" levels on the 2015 NAEP[e] math test (51 percent) is nearly twice that for Latino students (26 percent); and
- at eighth grade, the gap is even wider: 43 and 19 percent, respectively, at proficient or above.[46]

Latino children (and black children) starting kindergarten in 1998 had poorer math skills, on average, than their white peers.[47] During the first 2 years of school, the Latino -white gap narrowed by about a third, but then was fairly stable for the next 4 years.[48] There were also substantial disparities among Latino subgroups, as defined by national origin, immigrant generational status, and proficiency with the English language. Students with the lowest math achievement at kindergarten entry were those with Mexican and Central American origins, especially those who were first- or second-generation immigrants and not proficient in English. These students, however, also showed the most gains relative to white students over the early years of schooling.[49]

Reflecting, in part, these disparities, Latinos are substantially underrepresented in STEM-related programs and careers. For example, although Latinos and white undergraduate students are equally likely to major in STEM fields, Latino students are one third less likely than white students to complete their STEM degree.[50] Although Latinos make up 15 percent of the overall workforce, they are only 7 percent of the STEM workforce, according to Census Bureau figures.[51]

"Non-academic" skills: A glossary

Social-emotional skills: These include expressing emotion in socially appropriate ways, taking another's perspective, having self-confidence, and having the ability to get along well with others.

Approaches to learning: These commonly include attention, persistence, eagerness to learn, independence, and adaptability

Executive functioning: This is generally considered to be a set of skills that are a part of self-regulation. Executive functioning has three dimensions: holding and manipulating information in working memory; inhibiting thoughts and impulses in order to focus attention where its most needed; and mental flexibility, or the ability to adapt one's thoughts and attitudes to changing circumstances, or to devise new ways of problem-solving.

Self-regulation: This term encompasses a number of internal processes aimed at managing cognition and emotion, controlling impulses, and otherwise organizing behavior to achieve one's goals. It draws on, but is broader than, executive functioning, since it includes emotional as well as cognitive skills.

[e] National Assessment of Educational Progress, also known as "the nation's report card."

In spite of the barriers to their achievement, Latinos have made impressive progress in education over the past generation. Their enrollment in preschool programs is increasing, high school dropout rates have declined by more than half, their scores on both math and reading assessments have improved, and their rate of college enrollment is at an all-time high.[52,53]

Existing research suggests that numerous factors may hinder further academic success for Latino youth.[54] For example, the poverty rate for Latino children in 2015 (28.6 percent) is more than twice that for white children (11.5 percent).[55] Systemic bias, reaching down to the classroom level, negatively affects minority-group children.[56] However, the recent progress on multiple indicators[57] suggests that there are also points of leverage (at individual, family, community, and institutional levels) that, once identified, could inform efforts to further promote the academic achievement and life success of Latino students. The results summarized in this report describe aspects of Latino children's experiences in the home (e.g., primary language used), classroom, and school. The analyses consider whether these factors are associated with Latino children's math skills at kindergarten entry or with growth across the year.

Original Analyses of Latino Kindergartners' Early Math Skills

This section of the report describes original analyses of data from children who were in kindergarten for the first time during the 2010-to-2011 school year, with a focus on Latino children. Our goal was to understand how selected individual characteristics, as well as their home, classroom, and school contexts, were associated with Latino children's early math skills.

To put Latino kindergartners' math readiness in context, we begin by comparing their math and non-academic skills with those their black and white peers[f] at the start of kindergarten. Subsequently, we restrict our focus to Latino children, beginning with a summary of the associations between their math skills at kindergarten entry, and characteristics at the child and family levels. Then, we ask how these factors—as well as aspects of the classroom and school—are associated with Latino children's growth in math across the kindergarten year. We begin with a description of the data set and sample.

Overview of the sample

The sample was drawn from the Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011 (ECLS-K:2011).[g] This is a nationally representative sample of students who have been followed from their kindergarten year through the spring of 2016, when the majority were in fifth grade.

To address the questions in this study, we used information collected in the fall and spring of kindergarten. Because our focus was on Latino children getting their first exposure to kindergarten, we included only children who were enrolled for the first time during the 2010-11 school year. We further restricted the sample to children whose parents had completed surveys from the fall and spring of kindergarten, since those responses provided key information about the child's demographic characteristics and home environment, such as the primary language spoken in the home.[h] The ECLSK:2011 included 10,378 students who met these requirements, of whom 2,199 were Latino. This sample of 2,199 Latino kindergartners was the focus of this study.

[f] Our analyses excluded children of race groups representing fewer than 5 percent of first-time kindergartners.
[g] Comprehensive documentation is available on the National Center for Education Statistics website.
[h] 96 percent of the first-time kindergartners in the subset had both fall and spring math scores.

ECLS-K:2011 sampling weights were applied, so that the estimates in this report reflect the national population of Latino children who were in kindergarten for the first time in the 2010-11 school year.[i] Most of these 2,199 children (59 percent) had responses for every item of interest; for the other children, we imputed missing data.[j]

Early math skills assessment

The primary outcome measure was the researcher-administered math assessment, which included topics such as number sense, measurement, geometry, probability, and patterns. The assessment was administered in Spanish for Spanish-speaking children who did not pass an English language screening tool. The math scale captured the full range of children's abilities from kindergarten through first grade.[k] Possible values ranged from 0 to 96, with kindergartners generally scoring in the lower half of the scale. See the Appendix for details on the other measures.

To translate score differences into more meaningful terms, we used an approximation that equates each additional point on the math scale to an additional 2 weeks of learning, on average.[58,l] Of course, learning happens at different rates for each child, and even the same child may learn at different rates over the year.

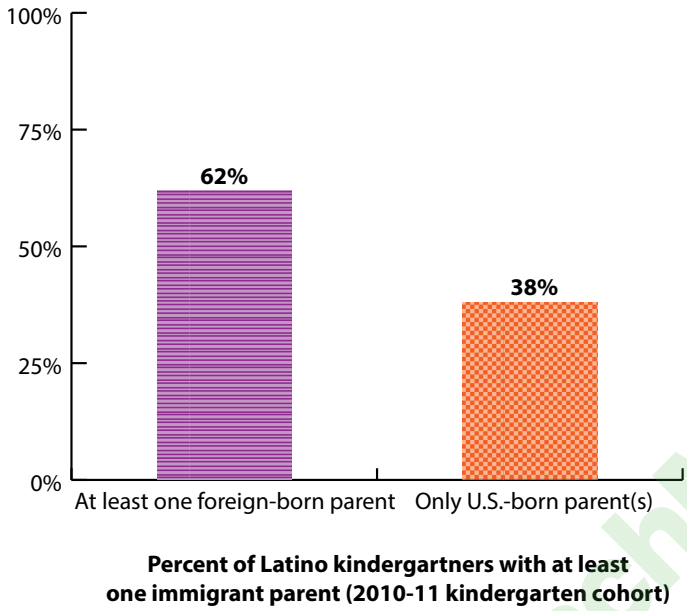
[i] Analyses in this report use the sampling weight "W12P0," the PSU "W12P0PSU," and the stratum "W12P0STR."
[j] We did not impute data for children who were missing parent reports in the fall and/or spring, because the ECLSK:2011 provides sampling weights for this subset. These sampling weights ensure that this subset remains nationally-representative. We imputed four data sets. All analyses were conducted on each imputed data set; results were then combined.
[k] At each time point, children only received a subset of math questions. The numerical score used in our analyses is the item-response-theory-based overall scale score. This score is an estimate of the number of items a child would have answered correctly if he or she had been administered all of the questions. See the ECLSK documentation on the NCES website for more information.
[l] See the Appendix for more information on this calculation.

Characteristics of Latino kindergartners

The Latino children who entered kindergarten for the first time in 2010 reflect the diversity of the broader Latino population in the United States, providing an important backdrop for understanding our study.

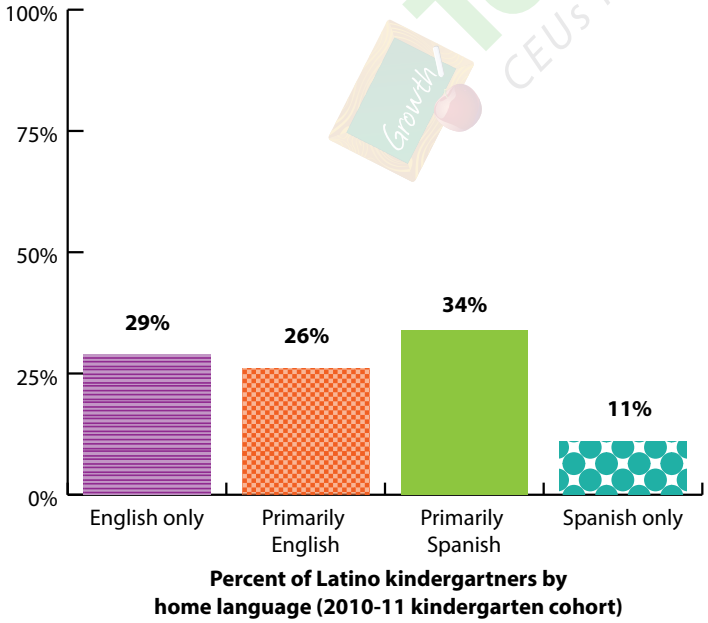
Roughly two thirds of these Latino kindergartners were from families with at least one foreign-born parent (see Figure 1). Twenty-nine percent lived in a household where only English was spoken (see Figure 2), and 9 percent had limited English proficiency on entering kindergarten (see Figure 3).

Figure 1. Two in three Latino kindergartners had an immigrant parent(s).



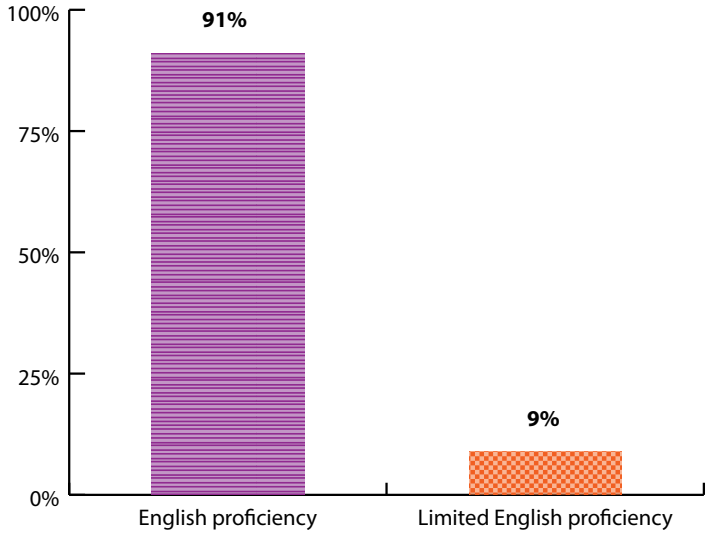
Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets.

Figure 2. Half of Latino kindergartners spoke primarily Spanish at home.



Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets.

Figure 3. Close to 1 in 10 Latino kindergartners had limited English proficiency.

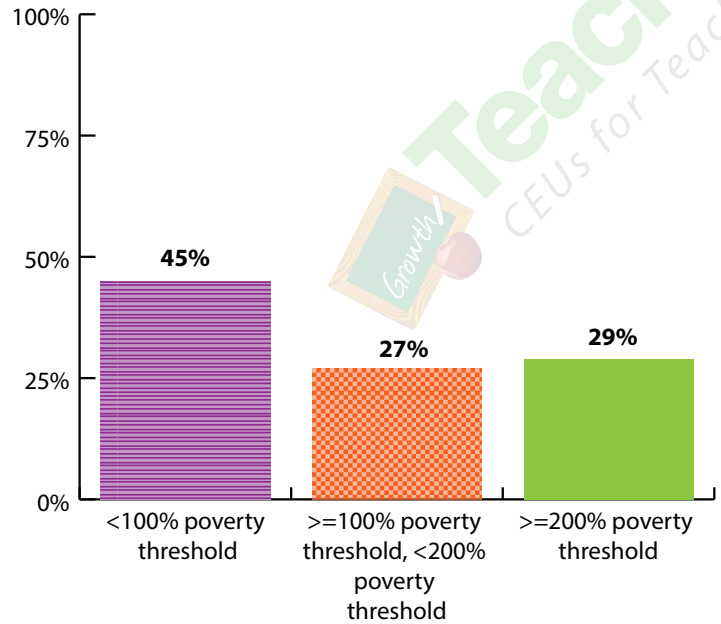


Percent of Latino kindergartners who had limited English proficiency at kindergarten entry (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets. Limited English proficiency is defined as not passing the ECLS-K's English screener during the fall child assessment. The English screener consisted of two tasks from the Preschool Language Assessment Scale (preLAS 2000).

Nearly half of Latino kindergartners lived in poverty (see Figure 4), and less than half had a parent with education beyond a high school degree (see Figure 5).

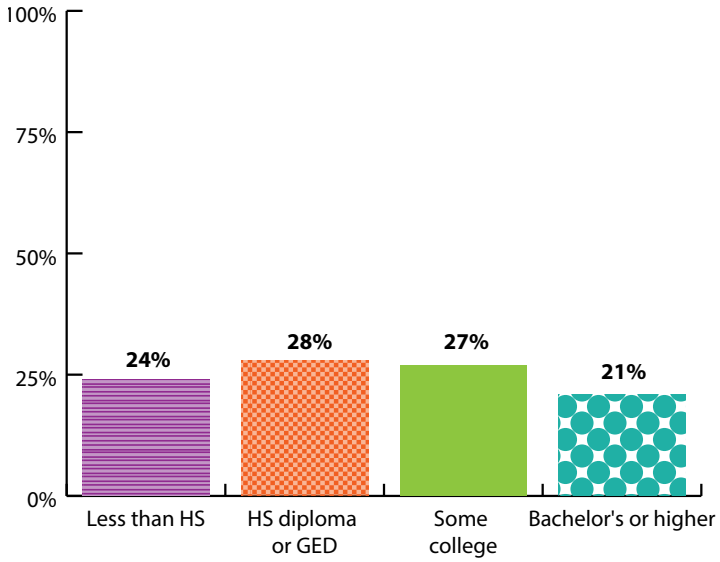
Figure 4. Close to half of Latino kindergartners lived in poverty.



Percent of Latino kindergartners by income-to-poverty ratio (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets. The federal poverty threshold refers to the annual household income below which a family is considered to live in poverty. The federal poverty threshold is calculated as triple the cost of a minimum-food diet, adjusted for household size and family composition. In 2015, for a family of four, the Federal Poverty Threshold was about $24,250 (Source: U.S. Census, http://bit.ly/2a62klM).

Figure 5. Less than half of Latino kindergartners had a parent with an education beyond high school.

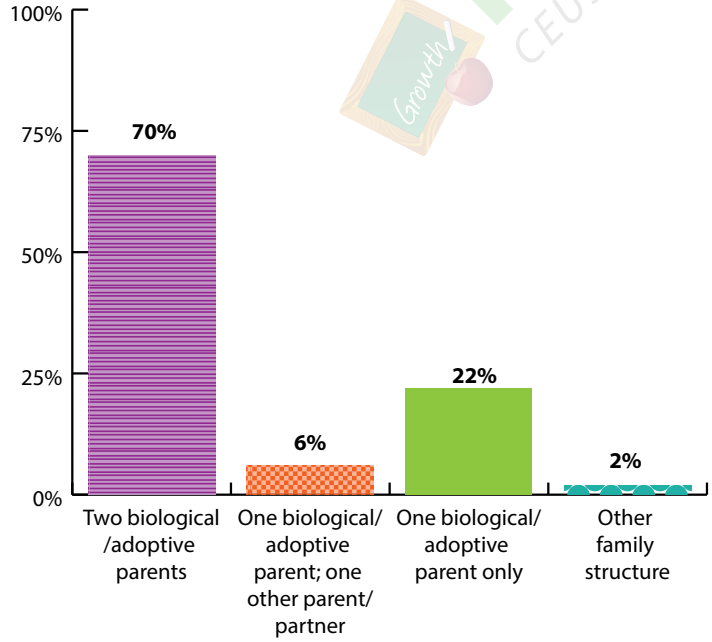


Percent of Latino kindergartners by parents' highest level of education (2010-2011 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets.

Latino kindergartners' home environments had several features that have been shown to promote early learning. The majority lived with both their parents (70 percent; see Figure 6). Half of Latino kindergartners had at least 30 children's books in their home (see Figure 7). At the start of kindergarten, about half of Latino kindergartners (59 percent) played games or worked on puzzles with their parents at least 3 to 6 times per week, based on parent reports (see Figure 8). Even more Latino kindergartners (89 percent) practiced numbers with their parents (reading, writing, or working with numbers, such as reading a calendar or working on homework) at least 3 to 6 times per week (again, based on parent report; see Figure 9).

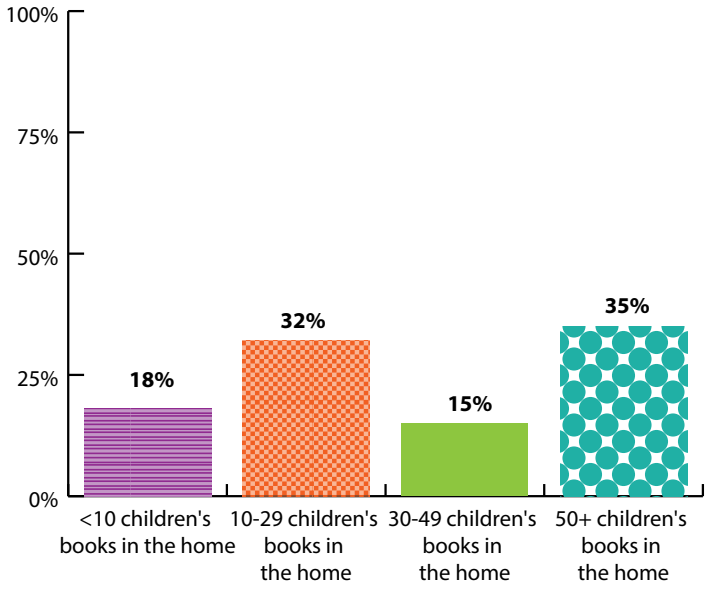
Figure 6. The majority of Latino kindergartners lived with two parents.



Family structure of Latino kindergartners (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets.

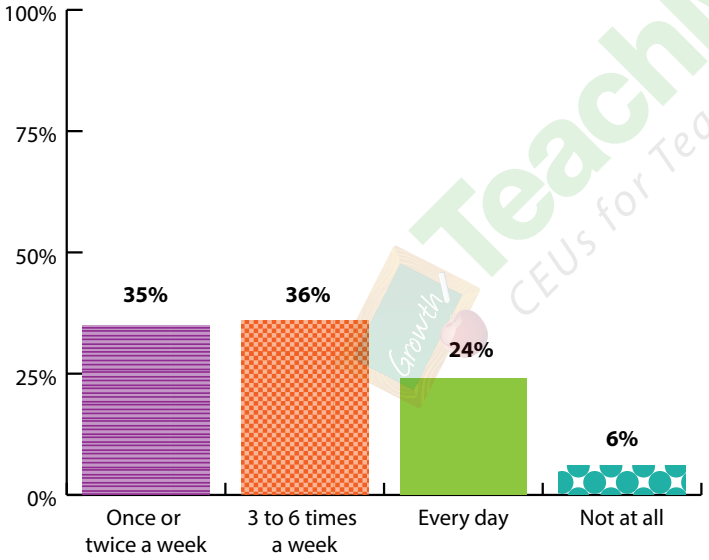
Figure 7. Half of Latino kindergartners had at least 30 children's books in their home.



Number of children's books in Latino kindergartners' homes (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets.

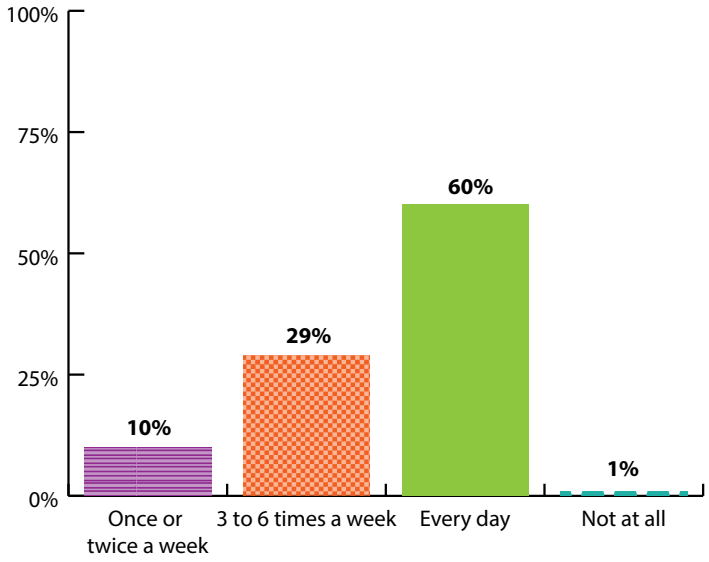
Figure 8. One in four Latino children played games or did puzzles with their parents every day.



Frequency with which Latino children play games or do puzzles with their parents (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets

Figure 9. Most Latino kindergartners practiced reading, writing, or numbers every day with their parents.

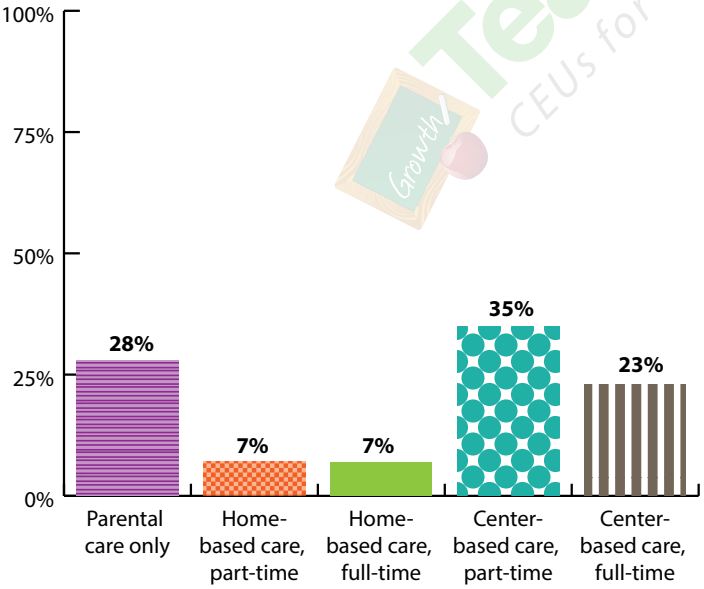


Frequency with which Latino kindergartners practice reading, writing, or numbers with their parents (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets.

Attending center-based care[m] in the year prior to kindergarten, and full-day kindergarten, were typical for Latino kindergartners. More than half attended a center-based program at least part-time in the year prior to kindergarten (see Figure 10). The great majority—84 percent—attended full-day kindergarten programs, with an average class size of 21 children.

Figure 10. Half of Latino kindergartners were in center-based care the year before kindergarten.



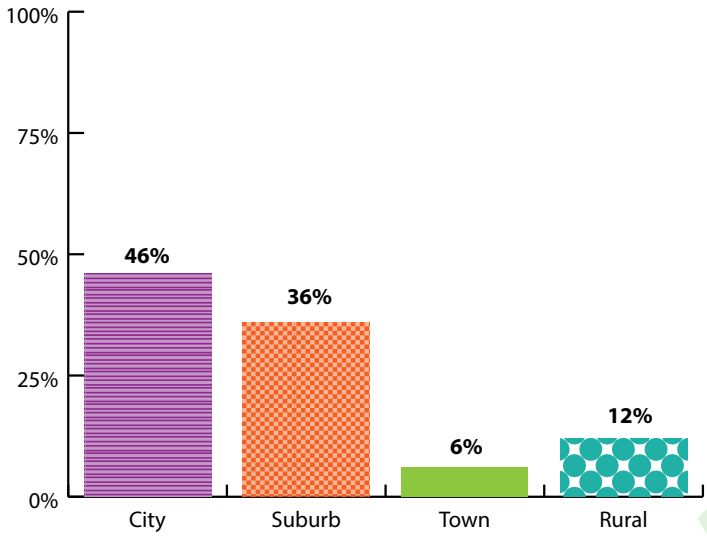
Prior year early care and education experiences of Latino kindergartners (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets

[m] Center-based care included day care centers, nursery schools, preschools, and pre-kindergarten programs, including state-funded pre-kindergarten programs and Head Start.

Typically, Latino kindergartners attended schools with other Latino and/or economically disadvantaged children. The average Latino kindergartner attended a school where 68 percent of students received free or reduced-price lunch, 51 percent of enrollment was Latino, and 32 percent of the school's kindergartners were classified as English-language learners. Most attended schools in cities (46 percent) or suburbs (36 percent), with 12 percent attending schools in rural areas (see Figure 11).

Figure 11. Roughly three quarters of Latino kindergartners attended school in cities or suburbs.



Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets.

Location of Latino kindergartners' schools (2010-11 kindergarten cohort)

In their kindergarten classrooms, Latino children received about 6 hours and 15 minutes of math instruction per week, on average. Roughly one third of Latino kindergartners were in classrooms where the teachers sometimes or always used Spanish for instruction.

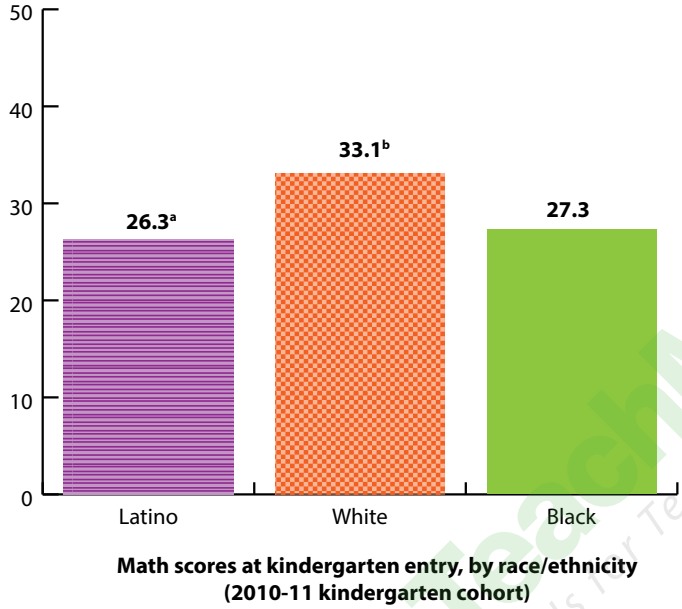
Latino kindergartners' non-academic and math skills: Summary of findings

In the following three sections, we describe findings from our primary analyses. First, we report on the early math and non-academic skills of Latino kindergartners, compared to their black and white counterparts'. Next, we describe the factors associated with Latino children's math scores *at the start of kindergarten*, followed presenting the factors associated with their *growth* in math over the kindergarten year.

In the fall of kindergarten[n]

Latino children's math skills lagged behind white children's at the start of kindergarten. Latino children's math scores were about 6.5 points—roughly equivalent to 3 months' learning—behind those of their white peers (see Figure 12).

Figure 12. Latino children began kindergarten with early math skills behind white children's, but on par with black children's.



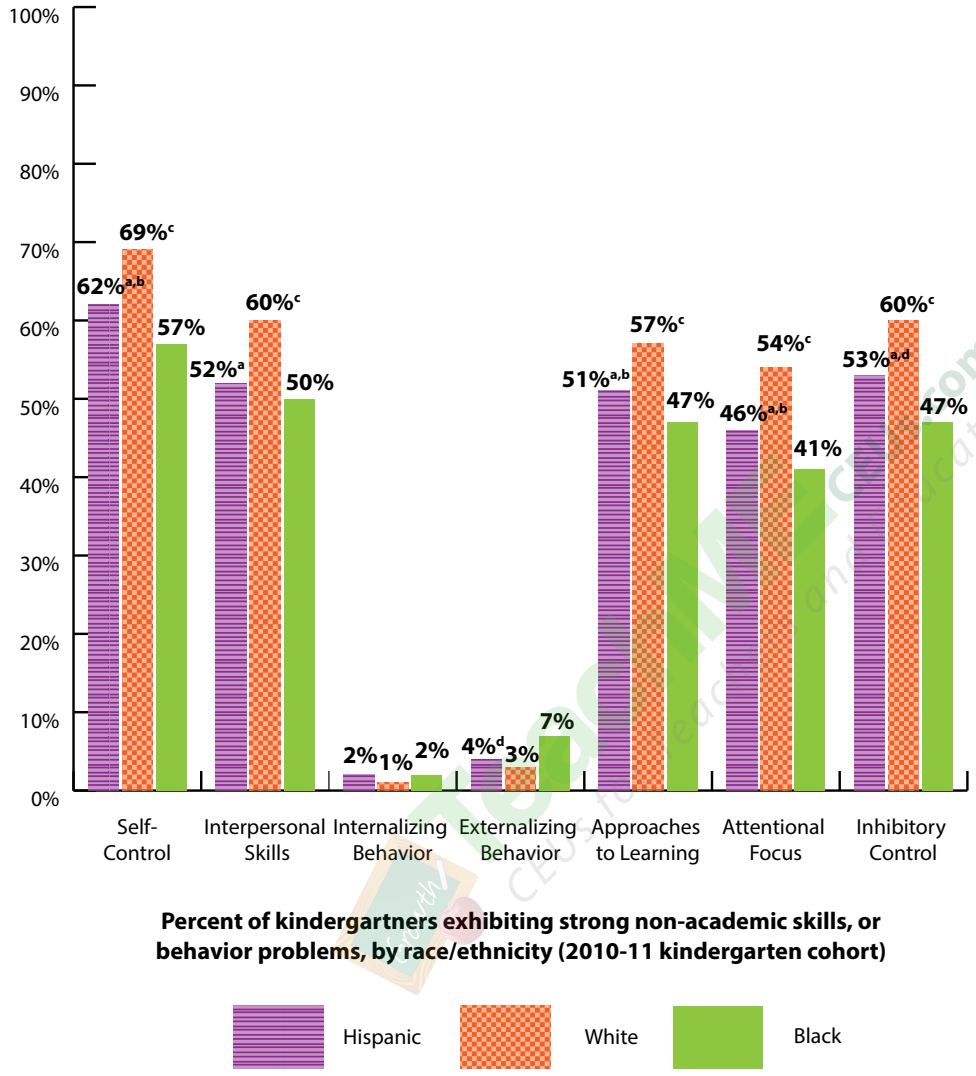
Math scores at kindergarten entry, by race/ethnicity (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Linear regression models controlled for children's age and gender. Estimates were pooled across four imputed datasets. The math scale was designed to capture the full range of children's abilities from kindergarten through first grade. Scores as reported are derived using item-response theory (IRT) techniques. Possible values for math scale ranged from 0–96.
[a] Latino students' scores are statistically different from whites' at the p<0.001 level.
[b] White students' scores are statistically different from blacks' at the p<0.001 level.

[n] We describe results from a linear regression (for math skills), and logistic regressions (for all non-academic skills). Analyses accounted for the effects of the child's gender and age at the time of assessment, but not for their socio-economic status or home environment. We assume that age and gender are not correlated with race/ethnicity. Not adjusting for age and gender could lead to inaccurate inferences about the gaps among the three racial/ethnic groups. Analyses used the sampling weight "W12P0," the PSU "W12P0PSU," and the stratum "W12P0STR."

Latino children were also less likely than white children to exhibit strong skills[o] related to self-control, positive interpersonal interactions, approaches to learning, and executive functioning, according to teacher reports (see Figure 13). Still, majorities of Latino children demonstrated strong self-control, positive interpersonal interactions, and approaches to learning, as well as executive functioning.

Figure 13. Many children entered kindergarten with strong non-academic skills, regardless of their race or ethnicity.



Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public-use data.
Notes: Logistic regression models controlled for children's age and gender. Estimates were pooled across four imputed datasets. Models control for child's age and gender. For Self-Control, Interpersonal Skills, Internalizing Behavior, Externalizing Behavior, and Approaches to Learning, children with "strong skills" had an average teacher report score of three or higher, indicating that the child tends to exhibit these behaviors "often" or "very often." For Attentional Focus and Inhibitory Control, children with "strong skills" had an average teacher report score of five of higher, indicating that the teacher tended to rate behavioral statements as "sightly true," "quite true," or "extremely true" for the child.
[a] Hispanics and whites are statistically different at the p<0.001 level
[b] Hispanics and blacks are statistically different at the p<0.05 level
[c] Whites and blacks are statistically different at the p<0.001 level
[d] Hispanics and blacks are statistically different at the p<0.001 level

[o] For Self-Control, Interpersonal Skills, Internalizing Behavior, Externalizing Behavior, and Approaches to Learning, "strong skills" were those where teachers gave an average score of three or higher, indicating the child exhibits these behaviors "often" or "very often." For Attentional Focus and Inhibitory Control, "strong skills" were where the average teacher report score was 5 or higher, indicating typical rating of items as "slightly true," "quite true," or "extremely true" for the child.

Math scores for Latino children and black children were similar. In regard to teacher-reported non-academic skills, Latino children were somewhat more likely than black children to exhibit self-control, positive approaches to learning, and executive functioning skills, and less likely to exhibit externalizing behavior problems (i.e., acting out).[p]

Factors associated with Latino children's math skills[q]

Certain characteristics of the home environment were associated with Latino children's math skills at the start of kindergarten. Children with higher math scores at the beginning of kindergarten were more likely to be from families with higher incomes. Knowing a Latino child's family income (below the poverty threshold, above the threshold but less than twice the threshold, or at least twice the poverty threshold) we can account for 12 percent of the variance in their math skills at kindergarten entry, before adding in other factors such as family structure or primary language spoken at home. Latino children with higher math scores also were more likely to have parents with more education, to live in a primarily English-speaking household, and to be proficient in English at the start of kindergarten.[r]

Latino children's early math skills were also higher when their parents reported having more children's books at home, and when parents practiced numbers with them more frequently.[s] Finally, Latino children who attended a center-based child care program in the year prior to kindergarten had higher math scores at kindergarten's start.

To illustrate these associations, we can compare the math scores of Latino children who differ on a single background characteristic, but who in other respects are similar.[t] For example, Figure 14 compares the fall math scores of Latino kindergartners coming from families with various income levels. Latino kindergartners from families living below the federal poverty level are the "reference category," or the group to which we compare other children. The figure shows that, in families with incomes at least twice the poverty level, children were a little more than 5 weeks (2.7 points) ahead in their math learning in the fall of kindergarten, compared to children in families living in poverty.

Similarly, Figure 15 compares fall math scores, based on the primary language used at home. Latino kindergartners from homes where only English was spoken are the reference category. Children who lived in homes where only Spanish was spoken, but are similar in other respects, started kindergarten with math scores 2.6 points lower, on average, than Latino children in English-only homes—the equivalent of about 5 weeks of learning for the typical child.

Figure 16 compares math scores of kindergartners based on the frequency with which their parents practiced numbers with them. Compared to Latino children whose parents did not practice numbers with them (the reference category), Latino children whose parents practiced numbers with them every day started kindergarten with math scores that were 1.9 points higher, on average—the equivalent of about 1 month of learning for the typical child.

Finally, Figure 17 compares math scores of kindergartners based on their early care and education experiences in the year prior to kindergarten. Compared to Latino children who received only parental care in the year prior to kindergarten (the reference category), Latino children who had attended full-time, center-based care started kindergarten with math scores that were 1.7 points higher, on average—the equivalent of about 3 weeks of learning for the typical child.

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[p] Follow-up analyses tested whether significant differences in non-academic skills between racial/ethnic groups remained when we compared children's scores using *continuous measures* of these skills. All differences remained significant, and no new significant differences emerged.

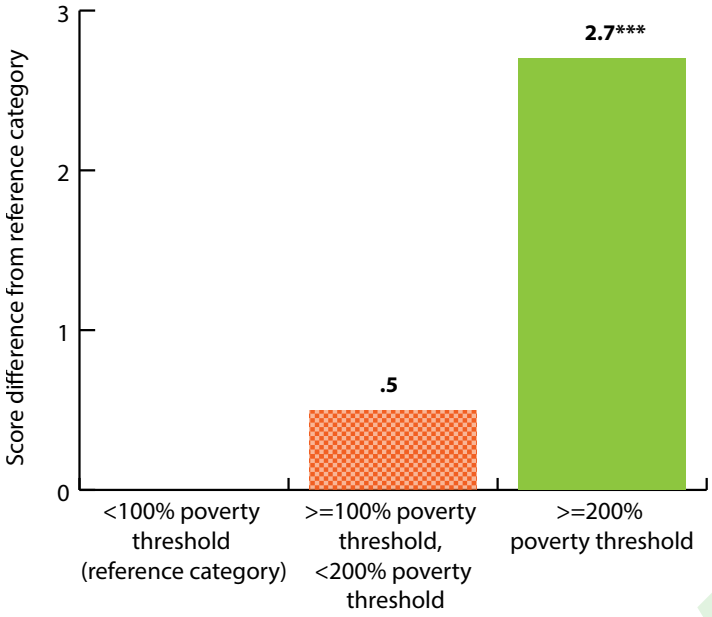
[q] This section describes results from a multivariate regression analysis predicting Latino children's math scores in the fall of kindergarten. Analyses used the sampling weight "W12P0," the PSU "W12P0PSU," and the stratum "W12P0STR." Predictor variables included all factors of interest. Children's age and gender were included as controls. This means that any factor that is significantly associated with math skills is *net of* the effects of age, gender, and other factors of interest. For example, the association between the number of children's books in the home and math skills at kindergarten entry is the effect *after accounting for* the effects of poverty, family structure, and other important factors. See Appendix B for the full set of results.

[r] Importantly, the math skills tested were not language-dependent; for example, children who received the math test in Spanish were permitted to count in that language.

[s] Parents were not asked whether they practiced numbers in English or Spanish.

t The factors held constant are listed in the "Note" in each figure.

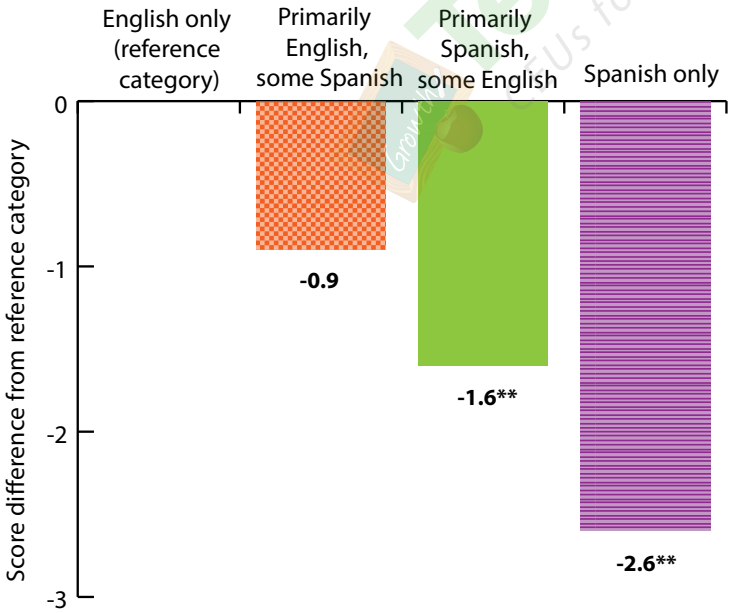
Figure 14. Latino children with family incomes that were at least twice the poverty level started kindergarten with math scores that were 2.7 points higher, on average, than children in poverty—the equivalent of about 5 weeks of learning for the typical child.



Adjusted differences in fall kindergarten math scores, by family income level (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets. Estimates adjust for children's sex, age, early care and education arrangement prior to kindergarten, English proficiency in the fall of kindergarten, parent education, number of children's books in the home, family structure, home language, frequency of parent playing games, and frequency of parent practicing numbers. Estimates pertain to a sample of Latino children who were enrolled in kindergarten for the first time in the 2010-11 school year. Actual math scores could range from 0 – 96. * p<.05, ** p< .01, *** p<.001.

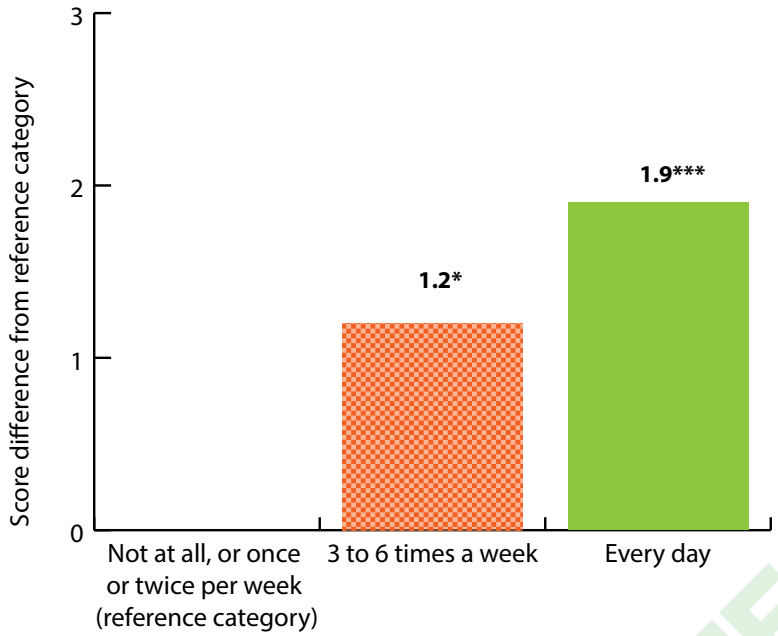
Figure 15. Latino children living in homes where only Spanish was spoken started kindergarten with math scores that were 2.6 points lower, on average, than Latino children in English-only homes—the equivalent of about 5 weeks of learning for the typical child.



Adjusted differences in fall kindergarten math scores, by the child's home language (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K: 2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets. Estimates adjust for children's sex, age, early care and education arrangement prior to kindergarten, English proficiency in the fall of kindergarten, parent education, number of children's books in the home, family structure, home language, frequency of parent playing games, and frequency of parent practicing numbers. Estimates pertain to a sample of Latino children who were enrolled in kindergarten for the first time in the 2010-11 school year. Actual math scores could range from 0 – 96. * p<.05, ** p< .01, *** p<.001.

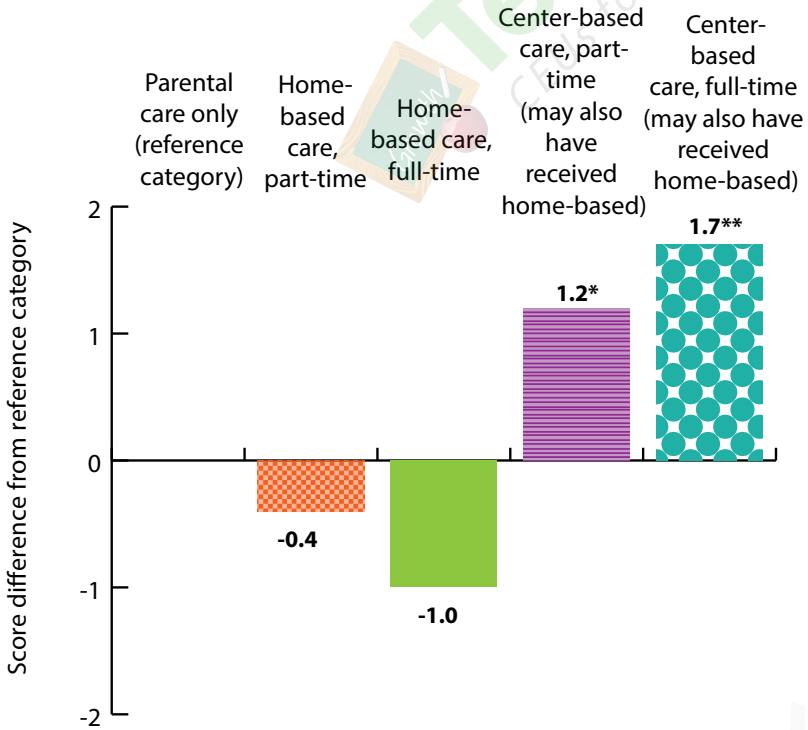
Figure 16. Compared to Latino children whose parents did not practice numbers with them, those whose parents practiced numbers with them every day started kindergarten with math scores that were 1.9 points higher, on average—the equivalent of about 1 month of learning for the typical child.



Adjusted differences in fall kindergarten math scores, by the frequency of practicing numbers (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K: 2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets. Estimates adjust for children's sex, age, early care and education arrangement prior to kindergarten, English proficiency in the fall of kindergarten, parent education, number of children's books in the home, family structure, home language, frequency of parent playing games, and frequency of parent practicing numbers. Estimatespertain to a sample of Latino children who were enrolled in kindergarten for the first time in the 2010-11 school year. Actual math scores could range from 0 – 96. * p<.05, ** p< .01, *** p<.001.

Figure 17. Latino children who attended full-time, center-based care in the prior year started kindergarten with math scores that were 1.7 points higher, on average, than those who received parental care only—the equivalent of about 3 weeks of learning for the typical child.



Adjusted differences in fall kindergarten math scores, by early care and education experiences (2010-11 kindergarten cohort)

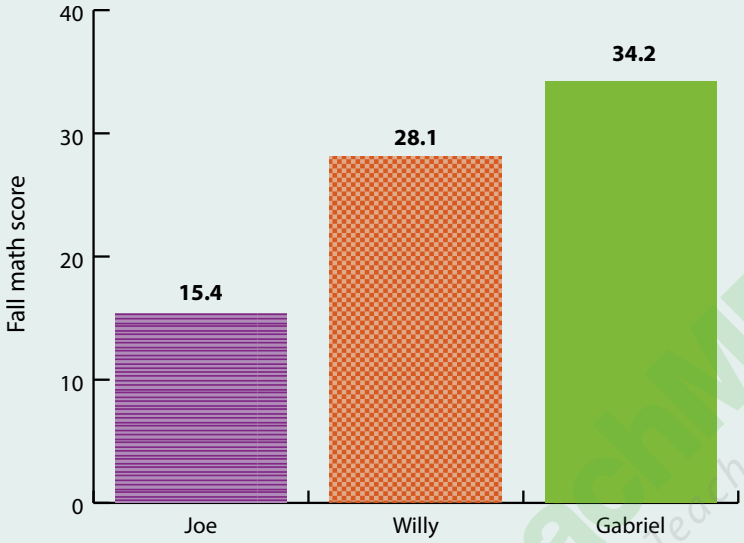
Source: Authors' analysis of first-time kindergartners in the ECLS-K: 2011 K-1 public use data.
Notes: Estimates are pooled across four imputed data sets. Estimates adjust for children's sex, age, early care and education arrangement prior to kindergarten, English proficiency in the fall of kindergarten, parent education, number of children's books in the home, family structure, home language, frequency of parent playing games, and frequency of parent practicing numbers. Estimates pertain to a sample of Latino children who were enrolled in kindergarten for the first time in the 2010-11 school year. Actual math scores could range from 0 – 96. * p<.05, ** p< .01, *** p<.001.

Three different Latino children, three very different math scores

Another way to think about the relationships between math scores and a number of other factors is to consider some hypothetical Latino children entering kindergarten with different backgrounds (see Figure 18). Given the associations described above, what are their math scores likely to be in the fall of kindergarten, under different scenarios?

Because our analyses showed that gender was not associated with Latino children's math scores at kindergarten entry, all three children in our example are boys, so that differences in math scores cannot be mistakenly attributed to gender differences. Similarly, neither family structure nor the frequency of playing games or puzzles with parents were associated, in our study, with children's beginning math scores, so all three children are assumed to have two parents who play games or puzzles with them about four days per week.

Figure 18. Three Latino children start the year with very different math scores.



Predicted fall math scores for three hypothetical Latino boys (see text for each child's background characteristics)

Source: Authors' analysis of first-time kindergartners in the ECLS-K: 2011 K-1 public use data.
Notes: Predicted math scores are based on estimates pooled across four imputed data sets. Predicted values account for children's sex, age, early care and education arrangement prior to kindergarten, English proficiency in the fall of kindergarten, parent education, number of children's books in the home, family structure, home language, frequency of parent playing games, frequency of parent practicing numbers, non-academic skills (approaches to learning, interpersonal skills, self-control, internalizing behavior, externalizing behavior), and several school environment factors. Estimates pertain to a sample of Latino children who were enrolled in kindergarten for the first time in the 2010-11 school year. Actual math scores could range from 0 – 96

Joe. Joe lives with his parents, Lisa and Mike, along with his two siblings. Joe's family lives below the poverty level, and neither of his parents has a high school diploma. In the year prior to kindergarten, Joe's mother cared for him at home. His family speaks only Spanish at home, and he entered kindergarten with limited English proficiency. His parents do not practice numbers with him, but they do play games or do puzzles with him about four days a week. He has a small number of children's books at home (about 20). **In the fall of kindergarten, Joe's predicted math score is 15.4, roughly 11 points, or about 5 months, behind the average Latino student's math score.**

Willy. Willy's family has an income slightly higher than the poverty level. In the year prior to kindergarten, he attended a center-based child care program full-time. His family speaks primarily English (and some Spanish) at home, and he was proficient in English by the fall of kindergarten. He lives with two parents, both of whom attended some college. His parents practice numbers with him every day and play games with him about 4 days a week. He has many children's books at home (about 40). **In the fall of kindergarten, Willy's predicted math score is 28.1. This is close to the average for Latino students, and 13 points (or about 6 months) ahead of where his classmate Joe started.**

Gabriel. Gabriel's family's income is more than twice the poverty level. In the year prior to kindergarten, he attended a center-based child care program part-time. His family speaks primarily English (and some Spanish) at home, and he was proficient in English by the start of kindergarten. He lives with two parents, both of whom have a bachelor's degree. His parents practice numbers with him every day, and play games with him about 4 days a week. He has a large number of children's books at home (about 80). **In the fall of kindergarten, Gabriel's predicted math score is 34.2.**

Note that many of the characteristics that define the Latino boys in our example (e.g., family poverty level, primary home language) may not be direct causes of higher or lower math scores. More likely, they reflect differences in the opportunities afforded to children, depending on their families' social and economic standing. Being poor, for example, may not in itself cause low math scores, but it could make it harder for parents to provide an enriching environment in the year prior to kindergarten. Similarly, families where Spanish is the sole language spoken at home are more likely to be recent immigrants who may be struggling with multiple challenges in a new environment.

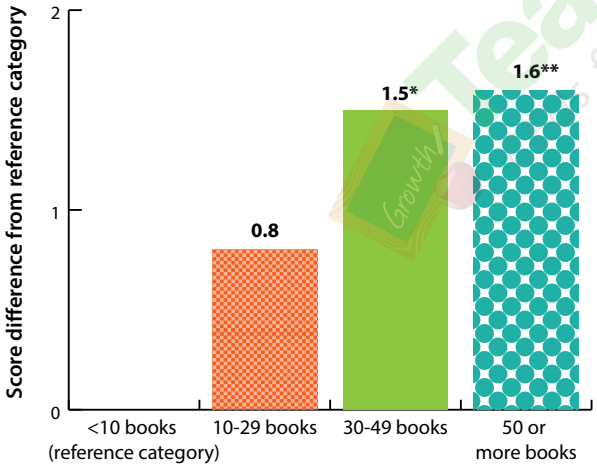
Growth in math skills over the kindergarten year[u]

Finally, we looked at which of the child characteristics and contextual factors described above were associated with growth in math skills for Latino children over the kindergarten year. Based on the increasing attention in research literature to the reciprocal relationships between academic and non-academic skills, we also examined whether Latino children starting school with relatively poor math skills made larger gains in math when their non-academic skills at kindergarten entry were strong, compared to the gains made by similar children with weaker non-academic skills.

Note that we use the terms *growth* or *gains* when describing associations between a characteristic (e.g., a child's executive function skills) and spring math scores, after controlling for the child's fall math scores and a number of other factors, such as poverty and home language.[v]

Latino children who started kindergarten with stronger executive function skills[w] made greater gains in math, compared to children with weaker executive function skills. Other factors associated with greater growth in math were having more children's books at home, and attending a full-day kindergarten, as opposed to a half-day program. For example, Latino children whose parents reported having 50 or more children's books in the home had math scores that were 1.6 points higher in the spring (about 3 weeks' worth of learning), compared to otherwise similar children who had fewer than 10 books (see Figure 19).

Figure 19. In the spring of kindergarten, Latino children with at least 50 children's books in the home scored, on average, 1.6 points higher in math—the equivalent of about 3 weeks of learning for the typical child—compared to those with fewer than 10 children's books.



Adjusted differences in spring kindergarten math scores, by the number of children's books in the home (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K: 2011 K-1 public use data.
Notes: Estimates adjust for children's fall math score, sex, age, early care and education arrangement prior to kindergarten, English proficiency in the fall of kindergarten, parent education, number of children's books in the home, family structure, home language, frequency of parent playing games, frequency of parent practicing numbers, non-academic skills (approaches to learning, interpersonal skills, self-control, internalizing behavior, externalizing behavior, and executive function skills), and several school environment factors. Estimates pertain to a sample of Latino children who were enrolled in kindergarten for the first time in the 2010-11 school year. Actual math scores could range from 0 – 96. * p<.05, ** p< .01, *** p<.001.

[u] We report findings from a multivariate regression model using the sampling weight "W12P0," the PSU "W12P0PSU," and the stratum "W12P0STR." Latino children's math scores in the spring of kindergarten were predicted by all of the factors of interest described in the previous section, as well as by children's non-academic skills and several classroom and school environment factors. The model also controlled for children's age, gender, number of months between fall and spring assessments, and fall math scores. This means that significant associations with spring math skills are *net of* the effects of the child's starting math score, age, gender, and other factors of interest. See Appendix C for the full set of results.

[v] See Appendix C for a list of all factors that were accounted for in the analysis.

[w] Children's scores on attentional focus were strongly associated with their scores on inhibitory control, so we averaged their two scores to obtain an overall measure of executive function. Several non-academic skills (executive function, approaches to learning, and self-control) predicted greater math growth when they were examined in separate analyses. However, when all non-academic skills were considered together, only executive functioning was significantly associated with greater gains in math.

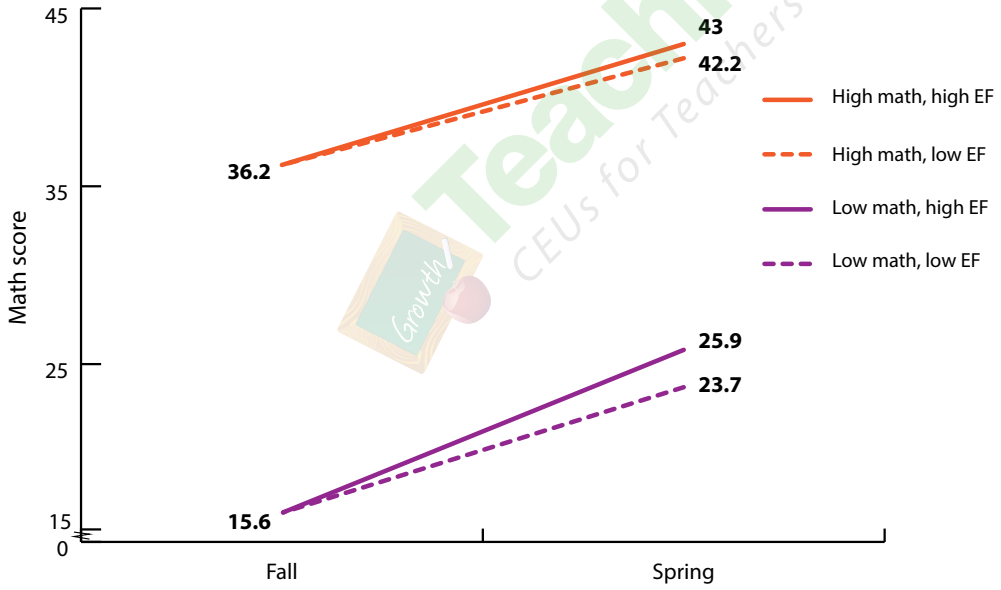
Surprisingly, the amount of time per week spent on math-related lessons or projects (based on teacher report) was unrelated to Latino kindergartners' growth in math over the year. Among the possible explanations for this finding are that the overall quality of early math instruction is generally poor, and that teachers' estimates of time spent on math activities may not include opportunities for math learning that are play-based, and which can be important adjuncts to formal instruction.[59]

Although many factors were *not* associated with greater gains in math for Latino children, some of the advantages attributed to these factors in the fall could still be seen in the spring. For example, although the frequency of parents' practicing numbers with their children was not associated with growth in math, children whose parents frequently practiced numbers with them retained their math advantage into the spring (compared to children whose parents practiced numbers less often). Conversely, Latino children whose English proficiency was limited in the fall—or whose families spoke primarily Spanish at home, or who had less-educated parents—had spring math scores that continued to lag behind those of their Latino counterparts.

The benefits of prior center-based care appear to fade out by the spring of kindergarten. By year's end, Latino children who were in center-based care in the year prior to kindergarten had math scores that are similar to those of their peers who had parental care only.

For Latino children who start out with poor math skills, executive functioning is especially important. For example, a child who begins kindergarten with a relatively low math score (15.6),[x] but high executive function skills (a score of 6, on a scale of 1 to 7), can be expected to have a spring math score that is 2.2 points higher than a child who started with the same low math score but poorer executive function skills. That is a difference of about 4 weeks of learning. For children who started kindergarten with an already-high math score (36.2),[y] executive function was less predictive of spring math scores (see Figure 20).

Figure 20. For Latino kindergartners with low fall math scores, starting with better executive functioning (EF) was associated with higher spring math scores.



Adjusted math scores in the fall and spring of kindergarten, by fall math score and fall executive function skills (2010-11 kindergarten cohort)

Source: Authors' analysis of first-time kindergartners in the ECLS-K: 2011 K-1 public use data.
Notes: Estimates are pooled across four imputed datasets. Estimates adjust for children's sex, age, early care and education arrangement prior to kindergarten, English proficiency in the fall of kindergarten, parent education, number of children's books in the home, family structure, home language, frequency of parent playing games, frequency of parent practicing numbers, non-academic skills (approaches to learning, interpersonal skills, self-control, internalizing behavior, externalizing behavior), and several school environment factors. Estimates pertain to a sample of Latino children who were enrolled in kindergarten for the first time in the 2010-11 school year. Actual math scores could range from 0 – 96. * p <.05, **p< .01, ***p<.001.

[x] This score is one standard deviation below the average score, as estimated in the sample of Latino first-time kindergartners.
[y] This score is one standard deviation above the average score, as estimated in the sample of Latino first-time kindergartners.

Patterns of math growth differ for Latino, white, and black kindergartners

Earlier, we described race/ethnicity gaps in math, adjusting only for children's age and gender. As seen in Figure 12, those gaps were considerable.

Here, we look at the *gains* made over the kindergarten year. Were there differences between white, black, and Latino children's learning across the year? Did achievement gaps remain at the end of kindergarten?

We found that gains in math over the kindergarten year were similar for Latino and white children, whereas black children's gains were smaller.[a] In other words, a white and a Latino child who started kindergarten with the same math score could be expected to achieve similar scores in the spring.

However, achievement gaps remained at the end of kindergarten. When we compared the average spring math scores for Latino, black, and white children—adjusting for gender, age, and time between assessments, but *not* their fall math scores—scores for white children were higher than those of both Latino and black children, whose spring math scores were similar. White children's spring math scores exceeded those of Latinos by 6.5 points (about 3 months of learning). Although Latino and white children may learn at the same rate during the kindergarten year, because they start kindergarten with lower math scores, Latino children do not catch up to their white peers by the end.

Do achievement gaps remain after adjusting for contextual factors?

Next, we examined whether achievement gaps remained after numerous background differences were accounted for. Indeed, even when children were assumed to be similar on a host of background characteristics—age, gender, early care and education in the year prior to kindergarten, parent education, poverty level, children's books in the home, family structure, home language, frequency of playing games or puzzles with parents, frequency of practicing numbers with parents, and limited English proficiency status—white children's initial math scores that were still significantly higher than Latino children's, with black children's scores similar to those of Latino children.

Moreover, even after adjusting for children's background characteristics and aspects of the classroom and school context (and controlling for fall math scores), white and Latino children made equivalent progress in math, while black children made smaller gains than both Latino and white children.

By the spring of kindergarten, Latino, white, and black children still had significantly different math scores after adjusting for background characteristics and classroom and school contexts. White children's scores exceeded those of Latinos by 1.6 points (about 3 weeks of learning). Black children's scores trailed those of Latinos by 1.5 points. These findings parallel those of other researchers who find persistent, though recently narrowing, achievement gaps related to race/ethnicity.[b]

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[a] We adjusted analyses to control for children's fall math scores and several potentially confounding factors: the child's age at the fall assessment, gender, and the amount of time between the two math assessments

[b] Reardon, S. F. & Portillo, X. A. (2016). Recent trends in income, racial, and ethnic school readiness gaps at kindergarten entry. AERA Open, 2(1), 1-18; Musu-Gillette, L., Robinson, J., McFarland, J., KewalRamani, A., Zhang, A., & Wilkinson-Flicker, S. (2016). Status and trends in the education of racial and ethnic groups 2016. U.S. Department of Education, National Center for Education Statistics.

Recommendations for Improving Latino Children's Early Math Skills

Children's early math skills develop in multiple contexts of family, school, neighborhood, and culture. As results from our study show, numerous factors influence how well prepared in math Latino children are when they start school, and how much progress they make over the kindergarten year. Some of these influences mark stubborn barriers to learning—poverty, prejudice, low parental education—that have proven relatively resistant to change. But others are points of leverage that are much more accessible.

Our findings show that, while Latino children make gains in math during kindergarten, those are not sufficient to close the achievement gap. If not properly addressed, this gap—and our nation's relatively low performance in math in general, relative to other countries'—will jeopardize our nation's readiness for an economic future where math and related STEM skills will be critically important. Much having to do with the context for early math skills development in general,[60] and that context for Latino children in particular,[61] is still poorly understood; but in this section, we highlight several key topics researchers might attend to. In order to maximize opportunities for early math learning, children's school experiences can be augmented by the efforts, starting in infancy, of parents and caregivers who provide environments rich in language (English, Spanish, or both) and varied learning opportunities. Policies and programs can play an important role in promoting and increasing access to these.

Our recommendations are drawn not only from our own analyses, but also from our broad review of the literature on the development of early math skills for all children, as well as findings specific to Latino children.

Recommendations for policymakers

1. **Broaden access to high-quality early care and education, and make it more responsive to the needs of Latino families with young children.**

   Latino children in the United States have historically lagged behind their white and black counterparts in their participation in center-based care.[62] The reasons for this gap are not all clear, but likely include access to and availability of affordable child care, families' socioeconomic resources, familiarity and comfort with publically funded programs and resources,[63] language and cultural barriers, and the timing and hours of care needed, to name a few. Although there have been recent encouraging gains in their participation,[64] perhaps reflecting responses to numerous reports focusing on the importance of the early years for brain development and general school readiness, more efforts are needed to inform Latino families about the value of high-quality early care and education, and to address barriers to access, which include affordability, availability, transportation, and the cultural sensitivity of care providers.[65]

   Child care generally is of uneven quality,[66] although there is evidence that the overall quality of center-based care has improved since the time our data were collected.[67] Given that a minority of preschool-aged children are served in formal, center-based programs,[68] it is particularly important to raise the quality of family-based settings.

   In our study, we found a positive association between Latino children's attendance, prior to kindergarten, in center-based care, and their math scores at the start of formal schooling. However, this association faded by spring of the kindergarten year. Other studies examining preschool interventions have found a fading-out of positive effects, especially for academic outcomes, after one or more years of formal schooling.[69] We suggest that one reason we found fade-out occurring as early as kindergarten may be that the center-based care experienced by children our national sample, in contrast to the higher-quality programs more typically studied, was likely extremely diverse in quality. We know both that quality matters, and that below a certain threshold of quality, positive effects cannot be expected.[70]

2. **Make full-day kindergarten available to all families, regardless of where they live.**

   Our findings show that when they attend full-day, rather than part-day, kindergarten, Latino children experience more growth in math skills over the year. This echoes other research that finds children in general who were enrolled in full-day kindergarten made greater in gains in both reading and math during kindergarten than their peers enrolled in a half-day program,[71] and that Latino children benefited especially.[72] In our sample, 84 percent already attend full-day kindergarten. Just 13 states require school districts to offer full-day kindergarten, and even where it is offered, the day may be shorter than that provided for first grade. However, not all states fund full-day kindergarten, limiting its accessibility for lower-income families. Some states do not make kindergarten, either full- or half-day, compulsory.[73]

3. **Adopt common standards for early math achievement.**

   There should be a national consensus on the early math skills children need to succeed, articulated with the nation's common core standards for K-12 math. Having these common standards will help raise the prominence of early math in the public eye, as well as provide a guide to educators on the breadth of math concepts young children need familiarity with.

Recommendations for organizations engaged in education and advocacy

1. **Use multiple forms of communication (e.g., videos, social media, personal contact) to help correct prevalent misunderstandings and anxieties about math, and to offer practical help to parents, teachers, and others on encouraging children's early math skills.**

   Parents of young children, while they appreciate the importance of math in helping children get ready for kindergarten, often have misconceptions about it. One survey found, for example, that parents discounted the importance of home activities such as building with blocks or doing puzzles—activities which, in fact, promote early math learning.[74] Other research finds that parents in the United States (in contrast to parents in East Asia) are more likely to over-emphasize the role of innate ability over effort in their children's math performance.[75]

   Organizations can help by supporting parents' efforts to engage with their children and widen their opportunities. Young children's experience, and especially their interaction with parents, makes a difference. Students with higher math achievement at fourth and sixth grades had attended preschool, had begun primary school able to perform simple numeracy tasks, and had parents who did early numeracy activities with them.[76] Too Small to Fail is one organization that has produced materials that are particularly accessible to parents.[77]

2. **Expand the reach of programs that make children's books freely available.**

   Promoting early literacy by providing parents with picture books to read with their children is an especially promising approach for addressing school readiness concerns, and is consistent with our findings of the importance of having children's books at home. Reach Out and Read[78] and Read for Success[79] are two evidence-based programs of this kind. It is important to know that reviews of these types of programs show that families can benefit regardless of whether they own, or simply borrow, the books.[80]

Recommendations for the education community

1. **Increase the supply and strengthen the preparation of teachers who can provide high-quality early math learning experiences.**

   A greater appreciation for the role of early math learning, and more intentional approaches to formal and informal instruction in math, may help close the achievement gap for Latino students and improve all students' chances for success.

   Mathematics instruction in the early years can be much improved. The National Council of Teachers of Mathematics and the National Association for the Education of Young Children have affirmed their position that "high-quality, challenging, and accessible mathematics education for 3- to 6-year-old children is a vital foundation for future mathematics learning."[81]

The minimal amount of attention given to early math instruction contributes to gaps in the kind of knowledge that provides the foundation for academic success. These gaps are especially evident among disadvantaged groups, and will persist and likely widen over time, if not addressed.[82] In elementary schools, the barriers to improved mathematics instruction include insufficient support from principals and inadequate knowledge among classroom teachers. Professional development for elementary school teachers that builds on a previous pre-K mathematics intervention can improve the long-term effectiveness of that intervention.[83]

The preparation of teachers needs to reflect the importance of math. Most educators of young children in the United States receive poor preparation for teaching mathematics, and in particular lack mathematics content knowledge appropriate for teaching young children.[84] When it comes to teaching math, low self-efficacy, even anxiety, is common.[85] When such attitudes are communicated to young children, they can inhibit their math achievement. Strengthening children's executive function, on the other hand, may help them counteract such influence.[86]

2. **Give greater attention to the special needs and strengths of dual language learners and their families.**

More attention should be given to the special needs and strengths of dual language learners (DLLs). When it comes to math learning for DLLs, teaching must address not only math vocabulary (such as words for numbers), but the language of mathematics (marking concepts such as measurement, equivalence, or spatial orientation).[87] Bilingual children may have an advantage in learning mathematical concepts because, having terms for them in two different languages, they can appreciate that mathematical ideas are abstract, not restricted to a specific terminology.[88] The best approach for teaching DLLs is in their first language—or, at least, to explicitly relate children's everyday language to the special language of math.[89] It is also important to draw on the specific cultural resources that bilingual children bring to math learning.[90]

3. **Improve the quantity and quality of developmentally appropriate mathematics instruction, including using a structured curriculum.**

A number of studies suggest that math learning needs to begin early in life, especially for children who are at risk for later academic difficulties. Assuming they have appropriate opportunities to learn, young children have a great deal of informal knowledge of math, and their play naturally includes substantial amounts of pre-mathematical activities.[91] However, high-quality mathematics education is instrumental in having young children reach their potential in math achievement.[92]

Among the elements of math that are important for young children to learn are numbers (including operations and relations), geometry, spatial thinking, and measurement. They also need to gain proficiency in the procedures that underlie both general and specific mathematical reasoning.[93]

Unfortunately, most early childhood classrooms are poorly equipped to help children learn math, and they reflect an underestimation of children's abilities.[94] Some children even experience a backward slide in their math skills during pre-kindergarten and kindergarten.[95] It is important for teachers of young children to conceptualize math as more than a set compilation of skills, and to include more than counting and simple shapes.[96]

Little time is devoted to "math talk" in most prekindergarten classrooms.[97] Even when math content is introduced, it is frequently not the main focus, but is embedded in other activities—an approach that research finds is not as effective as intentional teaching of math. Informal introduction of math ideas into children's play and other learning experiences is important, but should not substitute for a focused math curriculum. Math activities can help children develop social-emotional skills, as well as language skills. However, time spent in high-quality math instruction is important for promoting these skills.[98] Even preschool curricula promoted as "comprehensive" fail to include adequate math instruction. An evaluation of one such curriculum showed only 58 seconds out of a 6-hour day were devoted to math.[99]

In kindergarten, a bit more time is given to math—about 11 percent of the day.[100] However, there are still missed—or wasted—opportunities. Kindergarten teachers reported spending the most time on math concepts that most children entering kindergarten already know, which not only inhibits learning, but can lead to negative attitudes toward math.[101] In fact, most children benefit from having content that is challenging.[102]

The good news is that university education departments, school systems, and teachers have many tools to draw upon. Number competencies are malleable, and can be taught successfully to students with and without mathematics difficulties. Students who are at risk for problems with math can be reliably identified by measures that assess their skills with numbers, number relations, and number operations.[103]

Good math-related instruction for young children has the following features:[104]

- It is engaging.
- It involves significant mathematical concepts.
- It gives children access to materials to manipulate.
- It provides opportunities for problem-solving.
- It requires a degree of effort and persistence.
- It is able to involve children working collaboratively, discussing alternative solutions.
- It provides natural feedback that informs children's efforts.
- It gives children opportunities to take pride in their successful problem-solving.

4. **Incorporate activities that promote children's social-emotional learning and executive function.**

   Research reviewed here shows that skills in these areas are strongly associated with young children's competence in math, as well as in other academic subjects.

5. **Adapt instruction, linguistically and in other ways, so it is congruent with students' cultural backgrounds.**

   Teachers should understand that cultural background can have a strong influence on children's learning—including in math. The skilled teacher takes advantage of cultural diversity to support learning for all students. For example, one study examined the effects of using a supplemental math curriculum that integrated cultural knowledge and practices of Alaska Native people. A random-assignment evaluation found Alaska Native students' math ability improved more in the intervention group than it did with the existing curriculum.[105]

6. **Examine both explicit and implicit biases that may restrict children's math learning.**

   Research finds that some teachers may hold implicit biases—for example, presuming that Latino students are less competent than white students, regardless of their actual ability.[106] Such perceptions can contribute to Latino students' disengagement from academics, and their failure to make strong attachments to school and teachers. This plays out later in Latino students' being the least likely to take high-level math and science courses or to enroll in four-year colleges.[107]

7. **Help sustain the engagement of parents and other family members in children's learning, at school and at home.**

   Strong family engagement is central to promoting children's academic achievement. Family activities such as reading with, talking to, and playing with young children, lead to positive outcomes.[108] When relationships between families and early care and education providers are strong and positive, they reinforce children's learning; those relationships, in turn, are promoted by two-way communication and cultural and linguistic responsiveness.[109]

Promising early math curricula

There are several mathematics programs for preschoolers and kindergartners that have shown promising results. One is Building Blocks, a math curriculum for pre-K through second grade.[110] Building Blocks builds on the everyday activities of children, helping them to extend and "mathematize" these. Activities are built around children's experiences and interests. An experimental evaluation that included both Head Start and state-funded pre-K programs (both serving low-income families) showed the Building Blocks group had greater gains in scores than the comparison group.[111]

Another is Number Worlds, which emphasizes the quantity aspect of numbers, rather than simply their abstract symbols and rules for their manipulation.[112] Through the use of classroom games and props, children explore math concepts in a social context, and build a sequential understanding. The developers report significant gains in the number knowledge (and related areas) of at-risk children during kindergarten, and average or above-average performance that is maintained into first grade.[113]

Tools of the Mind, another kindergarten or pre-kindergarten program, incorporates support for children's self-regulation, particularly their executive function, into math, literacy, and science activities.[114] Evaluations of the program, to date, have shown mixed effects with regard to both math and non-academic skills; depending on the study, Tools of the Mind had positive effects on both[115] or neither,[116] or weak effects for math but none for social skills.[117]

Recommendations for parents

1. **Talk about math-related questions or tasks with children—using the language you are most comfortable with.**

Parents can use "math talk" to support children's readiness in math. With infants and toddlers, they can introduce number names and counting activities, as well as terms for spatial relationships (above, below, next to, and so on). Cooking, with or without recipes, is a natural entree for introducing counting as well as other measurement concepts. With preschoolers, parents can pose simple addition problems, and look for multiple opportunities to count, add, and problem-solve—out loud, with their child. Open-ended questions (ones that require more than a single-word answer) that extend math talk as long as possible are particularly effective.[118]

Families who use more than one language at home, or use a language different from the one children learn in school, can rest assured that children learn math concepts best in the language or languages they are familiar with.[119] The important thing is talking about math—in any language families feel comfortable speaking.[120]

2. **Make math fun by capitalizing on, or creating, opportunities to bring number concepts and related language into children's play.**

Everyday, playful activities are the best way for parents to introduce learning to young children, including math. It is important that parents show that they enjoy math activities if they want to help their children develop enthusiasm for math.[121]

Much of what parents do, or can do, to support their children's math learning may not even seem like math. Playing simple card games, like Go Fish, or board games; identifying shapes in books parents read with their child; inventing a shape or number hunt that takes the child throughout the home; or counting things (from buttons to birds)—together all can contribute to math learning.[122]

3. **Play games with children that may reinforce their emerging executive function skills.**

When it comes to promoting children's executive function, parents of infants can play lap games like peekaboo; rhyming games paired with movement (Trot to Boston, This is the Way the Farmer Rides, Pat-a-Cake, Aserrín Aserrán los Maderos de San Juan); hiding games; and imitation or copying games.[123]

With preschoolers, parents can encourage simple role-plays, especially those involving taking turns; a variety of active games (Freeze Tag, imitation games); and song games involving a sequence of required actions (Hokey Pokey, I'm a Little Teapot). Parents can narrate the day's activities; talk about feelings; tell stories. They can help children play matching/sorting games, and complete puzzles. Parents should encourage imaginary play. Parents and children together can play card games and board games.[124] Digital games can, in some cases, also enhance these skills, though parents are advised to monitor their child's use of these, to ensure it truly supports this kind of learning.[125]

Through a variety of activities, including number games and games that build their abilities to focus attention, manage impulses, and organize information, young children gain content knowledge, but also the critical skills related to the "how" of learning; these skills promote their learning of math concepts.

4. **Introduce a variety of activities that are rich in language and content about the wider world.**

   With all young children, starting in infancy, parents can foster their children's learning by reading books, telling stories, and singing songs—as frequently as possible. These activities build literacy skills and concept knowledge that are important in multiple areas of learning—including math.

5. **Build a collection of children's books, including those freely available or borrowed from a library.**

Recommendations for researchers

1. **Further investigate the development of early math skills, particularly through studies that delve deeply into the diverse Latino experience (e.g., differences in primary language used; country of origin).**

   Despite the growing Latino portion of the U.S. population, more research is needed on how best to serve the developmental needs of this group in ways that translate into later life success. Particularly, more research is needed on guiding Latino students onto paths for success in the STEM economy. Few studies have examined how trajectories of math skills development may differ by national origin, primary language, or recentness of a family's immigration experience.

2. **Develop valid assessments of early skills (both academic and non-academic) for Latino children, and for others from non-dominant cultural backgrounds.**

   Researchers frequently note that the great majority of measures of young children's development (including the ones used here) have not been adequately tested with Latino or other non-white samples, to assess their validity. Particularly in the case of assessments of children's social-emotional skills, there are concerns that measures normed with non-Latino samples may not be valid for Latino children, whose cultural backgrounds may reflect a different set of emphases when it comes to emotion expression, relating to adults, and other behavioral expectations for children.[126]

3. **Further investigate the potential role of bias in teachers' ratings of children's skills, their expectations for children's behavior, and their interactions with students.**

   There is growing evidence that bias, both explicit and implicit, as well as unequal opportunity, negatively affect the prospects of non-white children. Our findings that achievement gaps by race or ethnicity persist, even after controlling for multiple background factors, suggest that systemic discrimination may play a role.

Appendix A

Measures

Early math skills

Children's math achievement was measured in the fall of kindergarten, and again in the spring. Researchers administered the math assessment to each child at both time points. For Spanish-speaking children who did not pass an English language screener administered by the research team, the assessment was administered in Spanish.

The math assessment included topics such as number sense, measurement, geometry, probability, and patterns. The scale captured the full range of children's abilities from kindergarten through first grade. At each time point, children only received a subset of math questions. The numerical score used in our analyses is the item-response-theory-based overall scale score. This score is an estimate of the number of items a child would have answered correctly if he or she had been administered all of the questions. (See the ECLSK documentation on the NCES website for more information.) Possible values on the math scale ranged from 0 to 96, with kindergartners generally scoring in the lower half of the scale.

To translate score differences into more meaningful terms, we used the rough approximation that an additional point on the math scale can be considered equivalent to 2 weeks of learning, on average.[127] Downey, von Hippel, and Broh (2008) similarly translated children's math and reading growth to "points per week" using the ECLSK:1998 dataset, with the goal of describes differences in the rate of growth during the school year and over the summer.[128]

Non-academic skills

We relied on teacher reports of children's behaviors to assess children's social, emotional, and self-regulation skills at kindergarten entry. To measure children's **social skills**, teachers responded to questions about children's *self-control, interpersonal skills, externalizing problem behaviors,* and *internalizing problem behaviors.* Teachers reported how often students exhibited relevant behaviors, using a scale of 1 (never) to 4 (very often). To measure children's **approaches to learning,** teachers were asked about children's learning behaviors (e.g., keeps belongings organized, shows eagerness to learn new things). Again, teachers used a 4-point scale to rate children.

To measure **executive functioning**, teachers were asked about children's skills and behaviors related to *inhibitory control* and *attentional focusing.* For purposes of this assessment, inhibitory control meant that the child could "resist a strong inclination to do one thing and instead to do what is most appropriate or needed," whereas *attentional focusing* meant that the child could "focus attention on cues in the environment that are relevant to the task in hand."[129] Teachers indicated how true or untrue each statement was for the child, on a scale of 1 (extremely untrue) to 7 (extremely true). Children's scores on *attentional focusing* were strongly associated with their scores on *inhibitory control,* so we averaged their two scores to obtain an overall measure of executive functioning.

Socio-demographics and home environment

The majority of the information about a child's sociodemographic characteristics and home environment was obtained from a survey that was completed by one of the child's parents/guardians. Some questions were asked in the fall, and others were asked in the spring.

Parents' nativity status was determined on the basis of whether one or more parent was foreign-born. Parents also indicated the highest level of education attained for themselves and their partner. We used the **highest level of education** across the two parents for our analyses. Household income as a percentage of the **poverty level** was calculated by parents' report of their income and household size. The federal poverty threshold refers to the annual household income below which a family is considered to live in poverty. The federal poverty threshold is calculated as triple the cost of a minimum-food diet, adjusted for household size and family composition. In 2015, for a family of four, the federal poverty threshold was about $24,250.[130]

Parents also reported their **family structure** (e.g., two biological parents; one biological parent and one other partner) and their **home language(s)**; if two or more languages were spoken at home, parents indicated which was spoken most often, and which other language(s) were spoken.

Parents reported the **number of children's books** in the home, as well as how often, during a typical week, they **play games or puzzles** with the child, and **practice reading, writing or working with numbers** with the child.

Finally, children who did not pass the ECLS-K's English screener during the fall child assessment were considered to have **limited-English-proficiency**. The English screener consisted of two tasks from the Preschool Language Assessment Scale (*pre*LAS 2000).[131] If a child spoke had limited English proficiency and spoke Spanish, the math assessment was administered in Spanish. Children with limited English proficiency who did not speak Spanish were excluded from analyses.

Early care and education experiences

Parents indicated whether the child had attended different **types of non-parental care** during the year prior to kindergarten. Children were assigned to one of five categories: parental care only, part-time home-based care only, full-time home-based care only, part-time center-based care (may also have some home-based care), and full-time center-based care (may also have some home-based care). We considered children's enrollment full-time if they spent at least 30 hours per week in one type of care.

Classroom and school environment

Children were identified as being in **half-day** (morning or afternoon) or **full-day kindergarten**. Kindergarten teachers indicated their **class size** and the frequency of their using **Spanish for instruction**. Teachers were also asked how often the typical child usually works on math-related lessons or projects and, on the days that children work on math, how much time the typical child usually spends on math. We combined the information from these two items to calculate the average number of **hours per week that a child spends working on math**.

School-level demographic information was provided by the school principal/administrator, or his or her designee. School information included the percentage of children receiving **free- or reduced-price lunch,** and the **racial/ethnic composition** of the school. Administrators also indicated the percentage of the school's **kindergartners who are English-language learners**. The school's location was coded as city, suburb, town, or rural, based on NCES definitions.

Appendix B

Results from a multivariate regression analysis examining factors associated with Latino children's math scores at kindergarten entry			
Variable	**Estimate**	**SE**	**SIG**
Control variables			
Child's age at fall assessment	0.64	0.05	***
Child is female	0.35	0.50	NS
Child's early care and education experiences			
Parental care only (reference category)			
Home-based care, part-time	-0.37	0.87	NS
Home-based care, full-time	-0.96	0.68	NS
Center-based care, part-time (may also have received home-based)	1.22	0.53	*
Center-based care, full-time (may also have received home-based)	1.67	0.59	**
Sociodemographic characteristics			
Limited English proficiency	-4.08	0.73	***
Parent highest level of education			
Less than HS (reference category)			
HS diploma or GED	0.6	0.46	NS
Some college	2.36	0.58	***
Bachelor's or higher	5.32	0.72	***
Poverty level			
<100% poverty threshold (reference category)			
>= 100 % poverty threshold, <200% poverty threshold	0.51	0.47	NS
>=200% poverty threshold	2.7	0.65	***
Number of children's books in the home			
< 10 books (reference category)			
10-29 books	0.89	0.87	NS
30-49 books	1.96	0.88	*
50 or more books	2.69	1.13	*

Results from a multivariate regression analysis examining factors associated with Latino children's math scores at kindergarten entry, cont.			
Variable	**Estimate**	**SE**	**SIG**
Home environment			
Family structure			
Two biological/adoptive parents (reference category)			
One biological/adoptive parent; one other parent/ partner	-0.36	0.87	NS
One biological/adoptive parent only	-0.93	0.50	NS
Other family structure	-2.01	1.45	NS
Home language			
English only (reference category)			
Primarily English, some Spanish	-0.93	0.59	NS
Primarily Spanish, some English	-1.55	0.59	**
Spanish only	-2.63	0.80	**
Frequency of parent playing games or doing puzzles with child			
Not at all, or once or twice per week (reference category)			
3 to 6 times a week	0.53	0.49	NS
Every day	-0.27	0.53	NS
Frequency of parent practicing numbers (reading, writing, or working with)			
Not at all, or once or twice per week (reference category)			
3 to 6 times a week	1.21	0.51	*
Every day	1.93	0.58	***

Source. Authors' analysis of Hispanic first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes. Estimates are pooled across four imputed datasets.
*p <.05, **p< .01, ***p<.001.

Appendix C

Results from a multivariate regression analysis examining predictors of Latino children's growth in math across the kindergarten year						
	Model 1			Model 2: Add non-academic skills		
Variable	**Estimate**	**SE**	**p**	**Estimate**	**SE**	**p**
MODEL 1: Before adding non-cognitive skills						
Control variables						
Fall math score	0.87	0.02	***	0.84	0.02	***
Child's age at fall assessment	0.07	0.05	NS	0.06	0.05	NS
Child is female	0.1	0.3	NS	-0.34	0.32	NS
Months between fall and spring assessment	2.33	0.29	***	2.22	0.27	***
Child's early care and education experiences						
Parental care only (reference category)						
Home-based care, part-time	-0.73	0.59	NS	-0.77	0.59	NS
Home-based care, full-time	0.62	0.63	NS	0.57	0.61	NS
Center-based care, part-time (may also have received home-based)	-0.89	0.38	*	-0.86	0.39	*
Center-based care, full-time (may also have received home-based)	-1.3	0.52	*	-1.22	0.54	*
Sociodemographic characteristics						
Limited English proficiency	-0.42	0.59	NS	-0.16	0.57	NS
Parent highest level of education						
Less than HS (reference category)						
HS diploma or GED	-1.07	0.48	*	-0.98	0.48	*
Some college	-0.28	0.59	NS	-0.26	0.6	NS
Bachelor's or higher	-0.2	0.71	NS	-0.07	0.72	NS
Poverty level						
<100% poverty threshold (reference category)						
>= 100 % poverty threshold, <200% poverty threshold	0.31	0.5	NS	0.29	0.47	NS
>=200% poverty threshold	0.64	0.49	NS	0.61	0.5	NS

Results from a multivariate regression analysis examining predictors of Latino children's growth in math across the kindergarten year, cont.						
	Model 1			Model 2: Add non-academic skills		
Variable	**Estimate**	**SE**	**p**	**Estimate**	**SE**	**p**
MODEL 1: Before adding non-cognitive skills						
Number of children's books in the home						
< 10 books (reference category)						
10-29 books	0.78	0.49	NS	0.69	0.52	NS
30-49 books	1.46	0.63	*	1.36	0.64	*
50 or more books	1.63	0.52	**	1.52	0.54	**
Home environment						
Family structure						
Two biological/ adoptive parents (reference category)						
One biological/ adoptive parent; one other parent/partner	-0.12	0.67	NS	-0.02	0.67	NS
One biological/ adoptive parent only	-0.06	0.38	NS	0.14	0.37	NS
Other family structure	-1.84	0.89	*	-1.42	0.88	NS
Home language						
English only (reference category)						
Primarily English	-0.34	0.38	NS	-0.31	0.38	NS
Primarily Spanish	0.29	0.53	NS	0.07	0.53	NS
Spanish only	0.75	0.7	NS	0.37	0.7	NS
Frequency of parent playing games or doing puzzles with child						
Not at all, or once or twice per week (reference category)						
3 to 6 times a week	0.05	0.36	NS	-0.02	0.35	NS
Every day	-0.82	0.41	*	-0.75	0.38	NS
Frequency of parent practicing numbers (reading, writing, or working with)						
Not at all, or once or twice per week (reference category)						
3 to 6 times a week	0.64	0.45	NS	0.62	0.42	NS
Every day	0.64	0.43	NS	0.73	0.42	NS
School environment						
Percentage of children in child's school who receive free- or reduced-price lunch	0.02	0.01	*	0.01	0.01	*
Percentage of kindergartners in the school who are English language learners (ELL)	-0.02	0.01	*	-0.03	0.01	*

Results from a multivariate regression analysis examining predictors of Latino children's growth in math across the kindergarten year, cont.						
	Model 1			Model 2: Add non-academic skills		
Variable	**Estimate**	**SE**	**p**	**Estimate**	**SE**	**p**
MODEL 1: Before adding non-cognitive skills						
School environment						
Percentage of school that is Hispanic	0.02	0.01	NS	0.02	0.01	NS
Percentage of school that is white	0.005	0.01	NS	0.01	0.01	NS
Location of school						
City (reference category)						
Suburb	-0.19	0.48	NS	-0.19	0.48	NS
Town	0.87	1.00	NS	1.02	0.99	NS
Rural	0.26	0.57	NS	0.29	0.52	NS
Classroom environment						
Kindergarten is a full-day program	1.65	0.48	***	1.78	0.48	***
Class size	0.07	0.05	NS	0.07	0.05	NS
Spanish is used for instruction, at least sometimes	0.42	0.37	NS	0.43	0.33	NS
Hours per week spent on math[a]	0.07	0.06	NS	0.07	0.06	NS
Model 2: Add non-academic skills to Model 1						
Approaches to Learning (continuous measure)				0.25	0.45	NS
Self-control (continuous measure)				0.15	0.49	NS
Interpersonal skills (continuous measure)				-0.44	0.4	NS
Externalizing behavior (continuous measure)				0.29	0.34	NS
Internalizing (continuous measure)				-0.44	0.28	NS
Executive Function (continuous measure; average of Attention/ Focus and Inhibitory Control)				0.83	0.23	**
EF (continuous measure) X Fall Math				-0.05	0.01	***

Source. Authors' analysis of Hispanic first-time kindergartners in the ECLS-K:2011 K-1 public use data.
Notes. Estimates are pooled across four imputed datasets.
[a]Class size was capped at 29 in these public-use data.
*p <.05, **p< .01, ***p<.001. "

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"This document was developed from the public domain article: Make Math Count More for Young Latino Children – National Association of Latino Elected and Appointed Officials Educational Fund (NALEO), Mathematical Association of America (MAA), National Association for the Education of Young Children (NAEYC) and National Council of La Raza (NCLR), Child Trends (Publication # 2017-02)."