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# Do Family Investments Explain Growing Socioeconomic Disparities in Children's Reading, Math, and Science Achievement During School Versus Summer Months?

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In the face of rising economic and social inequality, American parents increasingly seek to promote their children's academic achievement through provision of enriching learning opportunities. In this study, we hypothesized that parental investments in both home and out-of-home learning resources may partially explain socioeconomic disparities in children's academic skills, and may function differently during school versus summer months. Using data drawn from the nationally representative Early Childhood Longitudinal Study Kindergarten Cohort of 2010–2011 ($N \approx 4{,}000$), we assessed children's reading, math, and science skills from kindergarten entry through second grade, attending to how achievement gaps shifted during school versus summer months. Multilevel piecewise latent growth models identified significant, small socioeconomic status (SES) gaps in children's academic skills at kindergarten entry. These initial SES gaps remained stable for reading skills, grew during school months for science skills, and grew during summer months for math skills. Significant, small family SES disparities in home reading-based learning activities, out-of-home enrichment activities, TV/video time, and time in summer camps/child care programs also emerged, helping to explain growth in SES achievement gaps. Specifically, growing SES gaps in science skills appeared driven in part through school-year home learning activities and summer out-of-home enrichment activities. Growing SES gaps in math skills also functioned in part through summer out-of-home enrichment activities. Results suggest the importance of enhancing year-round investments across home, school, and community contexts to support the school success of economically disadvantaged children.

***Educational Impact and Implications Statement***

Early academic skills are essential for setting children on a trajectory of academic, and eventually, career and life success. As such, socioeconomic gaps in early academic skills are of significant concern. This study used data from a nationally representative sample of approximately 4,000 children to show that children from economically disadvantaged families start school with small but significant detriments in reading, math, and science skills compared to their more advantaged peers and fall further behind in math and science skills during their early years of schooling. The results further found that disparities in children's exposure to home learning activities such as reading, as well as out-of-home enrichment activities such as going to libraries, museums, and zoos, were partially responsible for growing gaps in science and math skills between children from lower and higher SES families. These results highlight the importance of increasing children's exposure to learning opportunities and resources, particularly among children from economically disadvantaged families.

*Keywords:* economic inequality, summer learning loss, income achievement gaps, poverty, parental investment

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Since the 1970s, socioeconomic gaps across American families have widened considerably, primarily as a result of rising earnings and wealth at the higher end of the economic spectrum and wage stagnation among lower income and lower educated adults (Bradbury & Triest, 2016; Duncan, Magnuson, & Votruba-Drzal, 2015). Socioeconomic disparities across U.S. families constitute key concerns for the development and life chances of children. Starting in early childhood and extending into later life, children of higher socioeconomic status (SES) families have academic advantages over their lower SES peers that translate into differences in educational attainment, employment, and earnings in adulthood that drive the intergenerational transmission of advantage and disadvantage (Bailey & Dynarski, 2011; Coley, Sims, Votruba-Drzal, & Thomson, 2019; Duncan et al., 2015; Reardon, 2011). As socioeconomic disparities between families continue to rise in the U.S., it is crucial to better understand the mechanisms through which SES inequities lead to differential academic success.

In seeking to understand how gaps in academic achievement develop, researchers have tracked seasonal differences in the growth of academic skills. Numerous studies show that while children from socioeconomically advantaged and disadvantaged families exhibit similar gains in academic skills during the school year, the growth of academic skills among higher SES children outpaces that of disadvantaged children during the summer months (Alexander, Entwisle, & Olson, 2007; Burkam, Ready, Lee, & LoGerfo, 2004; McCoach, O'Connell, Reis, & Levitt, 2006). Often referred to as *summer learning loss* or *summer setback*, such disparities have been identified for decades, particularly in the domain of reading skills (Cooper, Nye, Charlton, Lindsay, & Greathouse, 1996). For example, using data from the Early Childhood Longitudinal Study–Kindergarten, 1998 cohort (ECLS-K: 1998), McCoach and colleagues (2006) found significant growth in reading skills during the school years of kindergarten and first grade, with minimal SES differences in growth rates. During the summer months, higher SES students showed reading skill gains while lower SES students suffered reading skill loss, increasing SES achievement gaps. Using the same data and assessing a broader range of academic skills, Burkam and colleagues (2004) found evidence that higher SES students experienced greater gains in both reading and math skills during the summer than did their lower SES peers. Given some evidence that SES gaps in young children's achievement may have declined in the past decade (Reardon & Portilla, 2016), it is important to consider this question in current cohorts of children.

In addition, in order to inform educational and community policies, it is essential to understand the processes driving SES gaps in children's academic skill trajectories. The family resource and investment framework provides a useful structure for addressing this question, arguing that heightened SES allows families to invest important resources in children that support academic success (Becker, 1991; Duncan et al., 2015). These investments may occur within families, through parental time and energy devoted to directly engaging in enriching activities with children, or through external experiences and contexts, such as high-quality educational opportunities and enriching out-of-school programs. Research on maternal time investments, for example, show that college-educated mothers of young children spend about twice as much time in play activities and about four times as much time in teaching activities than do mothers with less than a high school degree (Kalil, Ryan, & Corey, 2012). Similarly, work on family expenditures has documented that low-income families spend only 39% of the amount spent by high-income families on enriching materials and opportunities for their children such as educational programs, literacy materials, and extracurricular activities (Coley, Sims, & Votruba-Drzal, 2016; Kornrich & Furstenberg, 2013).

Extending this model to consider why family SES gives rise to differential growth of academic skills during the summer months, we must consider how children's environments differ between the school year and summer break. During the school year, children typically spend a large portion of their day in a highly structured and regulated environment with the primary aim of learning. Alexander and colleagues (2007) have argued that schools act as "equalizers" by providing similar sets of enriching resources to children across the SES spectrum and thus suggest that SES achievement gaps might decline over the course of students' schooling. Others counter this argument, pointing to disparities in the resources and educational quality provided in schools serving primarily advantaged versus primarily disadvantaged students (Chetty, Friedman, & Rockoff, 2014; Jackson, Johnson, & Persico, 2015), thus suggesting that SES disparities may continue to grow. There is more agreement concerning large SES differences in how children's time and investments are structured outside of school. During the summer, when any equalizing forces provided by schools are not available, SES disparities in children's time and investments are likely to gain prominence (Alexander et al., 2007). Some refer to this idea as the "faucet theory," which argues that academic investments will continue flowing during the summer for high-SES children due to parental inputs but will be less abundant for low-SES children when they are not in school (Entwisle, Alexander, & Olson, 1997).

Numerous studies have documented SES disparities in parental investments in children's development, such as time and materials related to reading and other learning activities in home settings, nonfamilial care (e.g., child care, summer camps), and out-of-home enrichment programs, all of which have also been associated with children's academic skills (Bradley, Corwyn, Burchinal, McAdoo, & Coll, 2001; Coley et al., 2016; Duncan & Brooks-Gunn, 1999; Kaushal, Magnuson, & Waldfogel, 2011). Other research has documented SES disparities in activities that might take time away from active learning, such as time spent watching TV or playing video games (Faught et al., 2017; Gershenson, 2013). However, relatively few studies have examined the potential mediating role these investments play in the summer setback phenomenon. One study that used time-series data from elementary schoolchildren in California found that SES gaps in time watching TV grew notably during the summer, whereas SES gaps in time spent reading were similar during the school year and summer, although this study was not able to link investments to children's academic skills (Gershenson, 2013). Another study utilizing the ECLS-K: 1998 data found that engagement in parent–child reading and educational outings (e.g., trips to the library, dance/music lessons, sports lessons) were more common among higher SES children, whereas TV viewing was more common among lower SES children during the summer months (Burkam et al., 2004). This study also found that summer literacy activities were associated with growth in reading skills but did not alter summer SES gaps in reading skills. Summer outings were associated with growth in math and general knowledge skills and their

inclusion in models led to small declines in SES gaps, although the authors did not test the significance of indirect paths (Burkam et al., 2004).

While this evidence suggests that summer investments differ by SES and may be associated with summer gains (or losses) in academic skills, the work on this topic has been minimal and has several key limitations. In particular, research in this area has not examined SES gaps in school year versus summer achievement gains in current cohorts of students who have experienced both growing economic disparities as well as increased efforts to improve the quality of low-income children's school contexts. Moreover, research has not systematically compared family learning investments in children during the school year versus summer. Neither has past research formally assessed whether SES variability in such investments help to explain seasonal variability in learning trajectories related to SES. The current study seeks to fill these gaps and build on past work by examining data from a recent nationally representative cohort of children. Using data from the ECLS-K: 2011, we tracked SES gaps in school year versus summer growth in reading, math, and science skills from kindergarten entry through second grade. Using rigorous analytic methods, we assessed whether family investments serve as mediators of SES achievement gaps. Based on prior work, we expected to see heightened SES disparities in summer versus school-year growth in children's academic skills, and we further expected that both in-home and out-of-home investments would serve as mediating processes helping to explain such gaps. Figure 1 presents our conceptual model.

# Method

## Sample

We drew data from the nationally representative cohort of over 18,000 children followed in the Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 (ECLS-K: 2011). The ECLS-K:2011 sampled children attending public or private kindergarten in the fall of 2010 and collected data twice a year in the fall and spring of kindergarten, first grade, and second grade and annually thereafter from parents, teachers, school administrators, and via direct child assessment. Response rates were 87%, 85%, 89%, 88%, 84%, and 87% for Waves 1 through 6, respectively. Only a purposeful, randomly selected subsample of respondents was included in fall data collection in first and second grade, during which parents reported on children's summer learning activities. Therefore, our analytic sample included the approximately 4,000[1] children that were part of this purposeful subsample, had a valid Wave 6 sampling weight (W6CF6P_2B0), were not homeschooled, and did not attend a year-long school. Sampling weights were included in all analyses to allow results to be generalized to a nationally representative kindergarten cohort.

Within our analytic sample, missing data ranged from 0.00 to 29.23%. Variables with over 20% of data missing included Waves 1, 5, and 6 reading outcomes (24.78%, 22.96%, and 21.06%, respectively); Waves 5 and 6 math outcomes (22.9% and 21.08%, respectively); Waves 5 and 6 science outcomes (22.94% and 21.1%, respectively); time spent watching TV during the school year (20.89%); and the covariates marital status (24.91%), immigrant status (20.71%), child age (24.2%), parent age (28.96%) and number of siblings in the household (29.23%). Full information maximum likelihood (FIML) in was used in Mplus to account for missing data.

Table 1 presents weighted descriptive data for the analytic sample. Children in the sample averaged 5 years 7 months at Wave 1; 48% were female; and 39% were White, 10% Black, 37% Hispanic, 8% Asian/Native Hawaiian/Pacific Islander, 2% Native American/Native Alaskan, and 4% multiracial. Just over one-quarter of children spoke English as a second language (ESL). Four percent were repeating kindergarten at Wave 1, and 5% repeated a grade between kindergarten and Grade 2. Nearly three-quarters of parents (73%) were married, and just over one third of families contained an immigrant parent. Ten to 11% of children attended private school at each wave.

## Measures

**Achievement.** Children's reading and math achievement were directly assessed at Waves 1 through 6 in the fall and spring of kindergarten, first grade, and second grade, and their knowledge and achievement in the domain of science was assessed in Waves 2 through 6. Assessments were completed in English or Spanish during the kindergarten and first grade waves, following an English competency screener (with children not showing competence in either of these languages skipping the cognitive assessments in these waves); starting in the second grade, all assessments were completed in English. These assessments utilized items from several validated and standardized instruments in order to achieve age-appropriate, reliable composites of children's skills in each of these domains. The reading assessments focused on basic skills like word recognition as well as vocabulary knowledge and reading comprehension. Math conceptual knowledge, procedural knowledge, and problem-solving skills were examined in the math assessment, and the science assessment covered physical science, life science, earth and space science, and scientific inquiry knowledge. IRT-scaled scores were created by the ECLSK: 2011 data administrators (reading $\alpha = .91–.95$; math $\alpha = .92–.94$; science $\alpha = .75–.83$; Tourangeau, Michael Brick, Lohr, & Li, 2017). To place these measures on a similar scale and capture growth over time in reading, math, and science achievement, we collapsed measures across waves (into long format) and standardized them within each achievement domain.

**Time.** We created measures of time spent in school and time spent on summer break at each wave using children's individual school start and end dates and assessment dates. We coded these variables using methods similar to those employed by Rambo-Hernandez and McCoach (2015) to create separate time-varying variables that captured cumulative time in school and cumulative time in summer each wave. In order to assess the possibility that growth in achievement varied over grades (Rambo-Hernandez & McCoach, 2015), we also created a quadratic measure of cumulative time in school each wave (time in summer, which only shifted in Waves 3 and 5, did not have enough data points for inclusion of a quadratic term). For example, for a child who was assessed on October 1 and May 15 each year, and whose school started and ended on September 1 and June 15 each year, the Wave 1 time in

[1] The National Center for Education Statistics stipulates that all *N*s be rounded to the nearest 50.

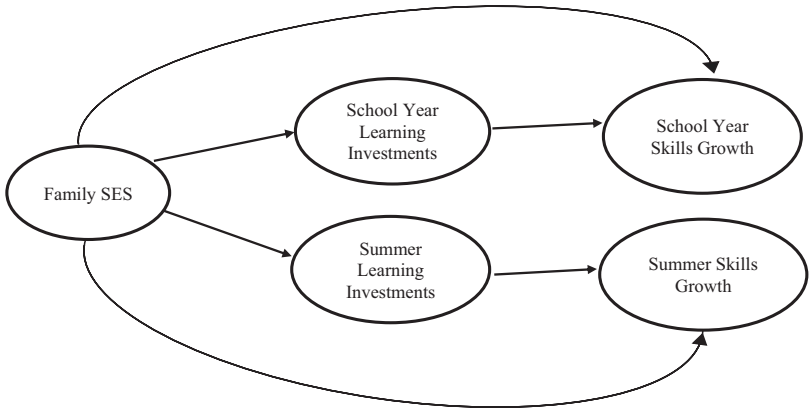


*Figure 1.* Conceptual model: Learning investments as mediators of family socioeconomic status (SES) connections with school year and summer academic skills growth.



school would equal 1 month and time in summer would be 0 months. At Wave 3, this child would have accrued 10.5 months in school and 2.5 months of summer. We coded these exact time variables in 3-month increments to ease interpretation.

**Family SES.** Each child's primary parent reported on family income and parental education and job prestige, which we combined into a composite measure of family SES. Parents reported on total family household income in the prior year at each wave. Parents reported their own and their spouse's educational attainment using categorical measures at Waves 1/2 and 4. We converted these measures to years of education, with the higher level of education attainment used to represent parent education in two-parent families. Parents also reported on their own and their spouse's occupation at Waves 1, 4, and 6, which was coded using the 1989 General Social Survey (GSS) prestige score to delineate occupational prestige, with the higher of the two values used in two-parent families (Tourangeau et al., 2014). Measures of the initial values of income, education, and occupational prestige were standardized and averaged into a kindergarten SES composite ($\alpha = .82$). We created a measure of cumulative SES by averaging each of the components of SES (household income, parent education, and occupational prestige) across all available waves, standardizing these scores, and then averaging them into a summary SES measure ($\alpha = .81$).

**Investment variables.** Four sets of investment variables assessed children's experiences of learning investments both within and outside of the home environment, with separate questions assessing children's experiences during summer months and school months. We selected items and constructs based on theory and prior empirical evidence, using exploratory factor analysis to group variables into conceptually and empirically reliable summary scores. We assessed four components of learning investments: home reading-based learning activities, time watching TV/videos, out-of-home enrichment activities, and time in camp/child care (recorded during the summer only). Because we were interested in assessing how academic skills grew during the summer versus the school year periods, we created separate school year and summer learning investment measures. For each component, we used reports from the spring waves (Waves 2, 4, and 6), with questions asking about children's experiences during a typical week or in the past 6 months, to create measures of school year investments. We used reports from fall waves in first and second grade (Waves 3 and 5), with questions asking about children's experiences during the summer, to create measures of summer investments. Because measurement often was not consistent across all waves, and because we did not expect learning investments to relate to children's gains in academic skills differentially across the time period assessed, we created time-invariant composite scores of school year and summer learning investments.

Parents reported on home learning investments each wave with two items assessing how many days per week parents spent time reading with their child and child spent time reading alone, both reported at Waves 1, 3, 4, 5, and 6. These variables were standardized and averaged at each wave, and then averaged into home learning investment variables for the school year and for the summer ($\alpha = .66–.68$). Parents also reported children's time spent watching TV/videotapes/DVDs at Waves 3, 4, 5, and 6, which we coded into 10 hr/week increments, then averaged and standardized for school year and summer time periods ($\alpha = .51–.65$). Parents reported on four items assessing out-of-home enrichment activities at Waves 2, 3, 5, and 6, including whether the child had gone to a library or bookstore; an art gallery, museum or historical site; a zoo, aquarium, or petting farm; or a play or concert in the past month. Items were summed within wave, averaged across waves, and then standardized into school and summer enrichment composites ($\alpha = .55–.75$). Parents also reported children's total time spent in *summer camp/child care* during each summer break (collected at Waves 3 and 5), which we coded into 40 hr increments, averaged, and standardized ($\alpha = .71$).

It is important to note that other items assessing potential investments were considered but not included as analytic variables due to inconsistencies in questions or uncertainty regarding the validity of the items. For example, the ECLS-K: 2011 asked about children's engagement in math activities with an adult but only assessed this during summer months, not during the school year. Questions concerning children's engagement in science projects and building games were assessed only in some school years, not during summer months. Similarly, questions

Table 1
*Weighted Sample Descriptive Statistics*

| Variable | *M*/% | *SD* | Min | Max |
|---|---|---|---|---|
| Reading Skills (unstandardized) | | | | |
| Wave 1 | 51.967 | 10.943 | 30.426 | 118.179 |
| Wave 2 | 65.768 | 12.963 | 31.412 | 118.179 |
| Wave 3 | 73.446 | 15.698 | 37.087 | 127.735 |
| Wave 4 | 90.051 | 16.102 | 38.036 | 128.526 |
| Wave 5 | 94.599 | 14.658 | 53.982 | 128.915 |
| Wave 6 | 102.732 | 13.324 | 53.855 | 128.915 |
| Math Skills (unstandardized) | | | | |
| Wave 1 | 33.965 | 11.130 | 8.956 | 82.024 |
| Wave 2 | 47.377 | 11.891 | 8.958 | 95.026 |
| Wave 3 | 56.161 | 15.324 | 19.084 | 119.334 |
| Wave 4 | 70.429 | 16.130 | 19.757 | 122.101 |
| Wave 5 | 75.614 | 15.850 | 10.933 | 118.632 |
| Wave 6 | 86.223 | 15.195 | 13.659 | 124.732 |
| Science Skills (unstandardized) | | | | |
| Wave 2 | 31.148 | 6.798 | 17.160 | 50.355 |
| Wave 3 | 34.820 | 8.639 | 17.468 | 73.313 |
| Wave 4 | 39.936 | 9.983 | 17.346 | 73.794 |
| Wave 5 | 42.752 | 9.744 | 14.781 | 70.358 |
| Wave 6 | 47.970 | 9.876 | 14.816 | 84.541 |
| School-time activities | | | | |
| Home learning activities (days/wk) | 4.473 | 1.376 | 0 | 7 |
| Television/Video time (10hr/wk) | 1.135 | .754 | 0 | 10.85 |
| Out-of-home enrichment activities | 1.892 | 1.048 | 0 | 4 |
| Summertime activities | | | | |
| Home learning activities (days/wk) | 4.538 | 1.627 | 0 | 7 |
| Television/Video time (10hr/wk) | 1.594 | .925 | 0 | 8.75 |
| Out-of-home enrichment activities | 2.166 | 1.038 | 0 | 4 |
| Camp/Child aare time (40hr/summer) | 2.194 | 3.237 | 0 | 15.796 |
| Family SES | | | | |
| Kindergarten family SES | −.023 | .924 | −2.490 | 2.721 |
| Cumulative family SES | .016 | .947 | −2.550 | 6.969 |
| Covariates | | | | |
| Child age (months) | 67.412 | 4.411 | 48.23 | 90.77 |
| Female | 48.18 | | | |
| Black | 9.79 | | | |
| Hispanic | 37.12 | | | |
| Asian | 7.99 | | | |
| Native American | 1.80 | | | |
| Biracial | 4.29 | | | |
| ESL | 25.78 | | | |
| Repeated kindergarten | 4.05 | | | |
| Repeated a grade (K-2) | 5.38 | | | |
| Parent age | 34.150 | 6.695 | 20.000 | 77.000 |
| Number of siblings in household | 1.538 | 1.169 | .000 | 12.000 |
| Parent separated | 15.18 | | | |
| Parent single | 11.68 | | | |
| Immigrant parent | 34.83 | | | |
| Northeast | 13.53 | | | |
| Midwest | 18.99 | | | |
| West | 34.11 | | | |
| Wave 1 public school | 89.80 | | | |
| Wave 2 public school | 89.57 | | | |
| Wave 3 public school | 89.04 | | | |
| Wave 4 public school | 89.55 | | | |
| Wave 5 public school | 89.37 | | | |
| Wave 6 public school | 88.78 | | | |

*Note.* Data derived from the restricted use Early Childhood Longitudinal Study-Kindergarten Class of 2010–2011 (ECLS-K: 2011) data waves 1–6 provided by the National Center for Education Statistics, U.S. Department of Education. SES = socioeconomic status; ESL = English as a second language.

concerning children's engagement in extracurricular activities such as music, drama, arts, and sports lessons were assessed only during the school year, not during the summer. Other questions concerning computer use and video gaming were not included due to inconsistent question wording regarding computer use and a lack of prior literature suggesting hypothesized positive or negative links with young children's growth in academic skills.

**Covariates.** Parents reported on numerous characteristics of children that were incorporated as covariates, including child gender, race/ethnicity (coded as White, Black, Hispanic, Asian/Native Hawaiian, Native American, or biracial), age (in months), English language status, and having repeated kindergarten, all assessed at Wave 1. We used administrative reports of the child's current grade, assessed at each wave, to create a dichotomous variable to indicate any grade repetition. Parent and family covariates, reported by parents, included marital status (married, separated/divorced or single), parent age (in years), whether either parent was an immigrant, and number of siblings in the household, reported at Wave 1. School administrators reported on geographic region, assessed at Wave 1, and school type (public or private), assessed at each wave and treated as a time-varying covariate.

## Analytic Technique

We modeled reading, math, and science achievement growth using Mplus (Version 7.4) via separate analyses employing multilevel piecewise latent growth models to identify growth during the school year from growth during the summer (Muthén & Muthén, 2012). Our analysis builds on piecewise regression methodologies employed in other research on this topic (McCoach et al., 2006; Rambo-Hernandez & McCoach, 2015), expanding prior work with the inclusion of mediating processes. We estimated two-level models with repeated measures over time (Level 1) nested within individuals (Level 2), with kindergarten school standard error cluster adjustments.

We first estimated unconditional growth curve models to assess patterns of growth in reading, math, and science skills. At Level 1, we estimated both a linear and a quadratic growth term to capture growth during school months and a linear growth term to capture growth during summer months. At Level 2, we estimated the random intercept and latent slope terms (with the school quadratic growth term fixed because we did not expect there to be individual differences in deceleration parameters).

In a second set of models, we added family SES at Level 2 using kindergarten SES to predict the intercept and cumulative SES to predict the school year and summer slopes. Using a kindergarten-specific SES composite to predict the intercept allowed us to capture only SES circumstances occurring at or prior to kindergarten, while utilizing a cumulative measure of SES over time allowed for a more stable SES construct with which to predict academic growth. After assessing the unadjusted SES differences in children's initial level and school and summer growth in academic skills, we estimated a third set of models adding covariates, including the time-varying measure of school type at Level 1, and the child and family covariates at Level 2 to assess the adjusted role of family SES on children's academic skills.

Finally, in a fourth set of models we included the investment variables, with school-year investments used to predict the school slope and summer investments used to predict the summer slope. We further modeled paths from cumulative SES to each investment variable, and tested indirect paths from SES to children's school and summer achievement growth through school and summer investments using the delta method through the "model indirect" command in Mplus (MacKinnon, 2008). This method adjusts for the covariance between path estimates, although when using continuous observed variables covariance terms are approximately 0 and as such the delta method is essentially equivalent to the Sobel indirect test (MacKinnon, 2008). We choose to use this default in Mplus rather than the option of bootstrapping in response to evidence that bootstrapping may increase Type I error rates and only improves results when used with very small samples or non-normal distributions, neither of which were present in our data (Koopman, Howe, Hollenbeck, & Sin, 2015; Shrout & Bolger, 2002).

# Results

## Descriptive Results

Table 1 presents weighted descriptive data on children's achievement scores and family investments. Descriptive statistics on unstandardized academic achievement scores showed increases in average scores through the waves, as expected. In terms of process variables (also presented unstandardized), children engaged with in-home enrichment activities over 4 days per week during both school and summer, and in about two out-of-home enrichment activities in the past month during the school year and summer. Their time watching TV/videos averaged just over 11 hr per week during the school year and nearly 16 hr per week during the summer, and time in camp or child care during the summer averaged just over 2 full-time weeks (i.e., 88 hr) for the duration of summer break.

Table 2 presents weighted bivariate correlations among the main variables of interest using data stacked over the waves. Results show significant positive associations between family SES and all academic achievement scores. As expected, both family SES and student achievement scores were positively correlated with home learning activities, out-of-home enrichment activities, and time in camp/child care, and were negatively correlated with TV/video time during both the school year and summer.

## Multilevel Latent Growth Curve Models Predicting Children's Achievement

Table 3 presents results from the unconditional latent growth models, which we estimated to show unadjusted patterns in children's growth in reading, math, and science achievement from fall of kindergarten through spring of second grade. Results indicate that children's academic skills grew significantly during both school year and summer months, with larger growth during school months. Specifically, children's reading skills grew .39 *SD* units per 3 months of school, which decelerated slightly over time from the start of kindergarten through the end of second grade, as indicated by the very small but significant negative quadratic of −.01 *SD*. This school growth was far larger than the summer growth rate of reading skills, .04 *SD*. Math skills also grew far faster during the school year versus summer, .35 and .03 *SD* per 3-month period, respectively, again with a very small but significant deceleration through school months, −.01 *SD*. Science skill gains were less starkly differentiated, with growth in science skills of .23 and .08 *SD* for school year and summer 3-month periods, respectively, and no deceleration over time in school year growth. Figure 2 presents predicted levels of achievement across the study period (kindergarten entry through second grade) for reading, math, and science. These patterns indicate positive growth across

Table 2
*Correlation Table*

| Primary variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Reading score | | | | | | | | | | | |
| 2. Math score | .887** | | | | | | | | | | |
| 3. Science score | .736** | .772** | | | | | | | | | |
| 4. Kindergarten SES | .232** | .235** | .327** | | | | | | | | |
| 5. Cumulative SES | .234** | .242** | .335** | .943** | | | | | | | |
| 6. School home learning environment | .100** | .061** | .140** | .200** | .192** | | | | | | |
| 7. School television/Video time | −.099** | −.101** | −.130** | −.259** | −.260** | −.222** | | | | | |
| 8. School out-of-home enrichment activities | .075** | .058** | .090** | .197** | .204** | .279** | −.134** | | | | |
| 9. Summer home learning activities | .088** | .045** | .134** | .157** | .145** | .577** | −.150** | .253** | | | |
| 10. Summer television/Video time | −.067** | −.090** | −.120** | −.218** | −.226** | −.197** | .485** | −.142** | −.169** | | |
| 11. Summer out-of-home enrichment activities | .166** | .161** | .261** | .426** | .430** | .325** | −.221** | .522** | .332** | −.221** | |
| 12. Summer time in camp/Child care | .057** | .066** | .075** | .157** | .149** | −.005† | −.003* | .006† | −.014* | −.029** | .092** |

*Note.* Data derived from the restricted use Early Childhood Longitudinal Study-Kindergarten Class of 2010–2011 (ECLS-K: 2011) data waves 1–6 provided by the National Center for Education Statistics, U.S. Department of Education. SES = socioeconomic status.
† $p < .10$. * $p < .05$. ** $p < .001$.

all academic domains during both school and summer months, with larger growth in reading and math than in science skills during school months, particularly in kindergarten, and greater summer gains in science than in the other domains.

Tables 4 and 5 present results from the next two sets of multilevel latent growth curve models exploring the role of family SES in predicting children's academic achievement. In the model without covariates, presented in Table 4, results indicate that kindergarten SES was significantly associated with intercepts of all academic skills, with effect sizes ranging from .24 *SD* units for reading and math to .29 *SD* units for science. Results were sparser in relation to growth in academic skills from kindergarten through second grade. Cumulative family SES was significantly associated with school year growth in reading and science, both with small effect sizes in which a 1 *SD* difference in family SES predicted about .01 *SD* greater growth in reading and science skills per 3-month period of school. Cumulative family SES was also associated with summer growth in math and science, with effect sizes of .04 and .03 *SD* per 3 months of summer, respectively.

These associations declined once models adjusted for a rich array of child and family covariates, as shown in Table 5. Effects of family SES on the intercepts of reading, math, and science skills declined by about a quarter to a half, to .19 *SD*, .18 *SD* and .14 *SD*, respectively. Associations with children's growth in academic skills also declined, with cumulative family SES retaining significant links with school year growth in science, .01 *SD*, and summer growth in math, .02 *SD* (with a similarly sized link with summer growth in science, .02 *SD*, that did not reach statistical significance). These patterns represent SES gaps of about 1/6 of a *SD* at the beginning of kindergarten across academic domains, with small increases in science SES gaps during the school year and math SES gaps during the summer. Figure 3 presents these growing SES gaps in science skills as an exemplar, showing the growing gaps between children in families 1 *SD* below and 1 *SD* above the mean SES.

As expected, child and family covariates were also significantly associated with both initial levels and growth in children's academic skills. Being younger, male, Black, Hispanic, or Native American, being an ESL learner, living in an immigrant family, with more siblings, or with separated parents, and attending public school all were associated with significantly lower initial levels of academic skills. In contrast, being older, Black, Hispanic, or Asian, being an ESL learner, having repeated a grade, and having younger parents were associated with significantly lower achievement growth, particularly during the school year.

Table 6 presents results from the multilevel latent growth curve models that included family investment variables as predictors of children's school and summer achievement growth and tested indirect effects from cumulative family SES to children's achievement growth through family investment processes. Cumulative

Table 3
*Unadjusted Multilevel Path Models Predicting Academic Skills Growth*

| | Reading skills | Math skills | Science skills |
|---|---|---|---|
| Outcomes and predictors | B (*SE*) | B (*SE*) | B (*SE*) |
| Academic outcome on | | | |
| Intercept | −1.430** (.016) | −1.383** (.016) | −1.245** (.027) |
| Time in school | .386** (.005) | .354** (.004) | .230** (.012) |
| Time in summer | .041** (.008) | .033** (.009) | .084** (.012) |
| Time in school squared | −.013** (.000) | −.009** (.000) | −.001 (.001) |

*Note*. Time was measured in 3-month increments. Data derived from the restricted use Early Childhood Longitudinal Study-Kindergarten Class of 2010–2011 (ECLS-K: 2011) data waves 1–6 provided by the National Center for Education Statistics, U.S. Department of Education.
** $p < .001$.

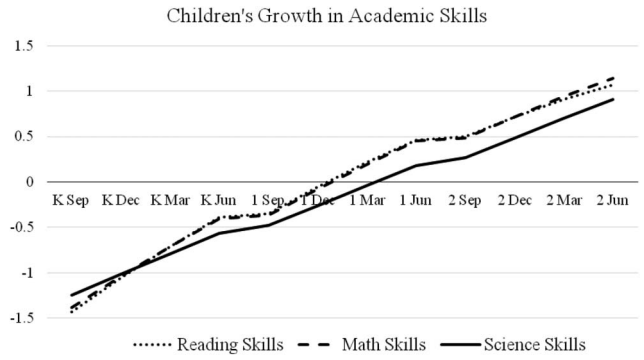


*Figure 2.* Children's growth in academic skills from kindergarten through second grade. Values presented in standardized units. Data derived from the restricted use Early Childhood Longitudinal Study-Kindergarten Class of 2010–2011 (ECLS-K: 2011) data waves 1–6 provided by the National Center for Education Statistics, U.S. Department of Education.

family SES showed significant associations with all of the investment variables, with each *SD* difference in cumulative family SES predicting .22 *SD* and .18 *SD* unit differences in home learning activities during school and summer periods, respectively, and .24 *SD* and .45 *SD* differences in out-of-home enrichment during the school year and summer. Family SES was also positively associated with time spent in summer camps/child care programs, .18 *SD*. In contrast, associations with TV/video time were negative during both the school year and summer, −.27 *SD* and −.22 *SD*. These results represent small to moderate sized SES gaps in children's exposure to learning investments, with no consistent pattern in which gaps were larger during the school months versus the summer months.

In contrast to the consistently significant links between cumulative family SES and children's exposure to learning investments, the links between learning investments and growth in children's academic skills were smaller and more sporadic, particularly during the school year. Each 1 *SD* difference in school year home learning activities was associated with small gains in science skills of .01 *SD* units per 3-month period. Neither school year out-of-home enrichment activities nor TV/video time were significantly associated with growth in academic skills. Summer learning investments were more consistently associated with learning gains. Specifically, summer home learning activities and time watching TV/videos were each associated with .01 *SD* unit gains in reading skills per 3-month summer exposure. Summer out-of-home enrichment activities were associated with gains of .01 *SD* in math skills and .03 *SD* in science skills per 3-month period.

The final panel of Table 6 presents indirect effects. A significant indirect effect emerged between cumulative family SES and school year gains in science skills running through home learning activities. Family SES also retained a significant direct effect with school year gains in science skills, with both effects being very small (.01 *SD* or less). In relation to children's gains in skills during summer months, family SES was positively associated with summer gains in both math and science skills through summer out-of-home enrichment activities (both .01 *SD*), with SES retaining a significant direct link with summer math skill gains as well (.02 *SD*). Family SES also was positively associated with summer gains in children's reading skills through summer home learning activities, but negatively associated through summer TV/video time, both with similarly small effect sizes of .01 *SD* or less.

## Alternate Model Specifications

We estimated a number of alternative model specifications to test the robustness of results. These robustness checks included estimating a set of models incorporating measures of family income rather than the SES composites and another set using a measure of home learning activities that included an item assessing practicing writing or math activities (which was assessed using different wording and response categories across waves). Results (not shown) did not vary substantially from those reports in Tables 3 through 6. We also conducted additional analyses to further explore the unexpected positive association between TV/video time and growth in children's reading skills during the summer. The negative bivariate relationship between these variables shifted direction when other family investments were accounted for, suggesting a relationship affected by collinearity or suppression.

Table 4
*Multilevel Path Models Predicting Academic Skills Growth Through SES*

| Outcomes and predictors | Reading skills B (*SE*) | Math skills B (*SE*) | Science skills B (*SE*) |
|---|---|---|---|
| Academic outcome on | | | |
| Intercept | −1.442** (.012) | −1.395** (.011) | −1.258** (.025) |
| Time in school | .386** (.005) | .353** (.004) | .228** (.012) |
| Time in summer | .041** (.008) | .031** (.009) | .083** (.012) |
| Time in school squared | −.013** (.000) | −.009** (.000) | −.001 (.001) |
| Kindergarten family SES | .235** (.012) | .243** (.010) | .291** (.016) |
| Time in school slope on | | | |
| Cumulative family SES | .007* (.002) | .000 (.002) | .012** (.003) |
| Time in summer slope on | | | |
| Cumulative family SES | −.001 (.007) | .037** (.007) | .028* (.010) |

*Note.* Time was measured in 3-month increments. Data derived from the restricted use Early Childhood Longitudinal Study-Kindergarten Class of 2010–2011 (ECLS-K: 2011) data waves 1–6 provided by the National Center for Education Statistics, U.S. Department of Education. SES = socioeconomic status.
* $p < .05$. ** $p < .001$.

Table 5
*Multilevel Path Models Predicting Academic Growth Through SES, Adjusting for Covariates*

| Outcomes and predictors | Reading skills B (*SE*) | Math skills B (*SE*) | Science skills B (*SE*) |
|---|---|---|---|
| Academic outcome on | | | |
| Intercept | −1.285** (.037) | −1.253** (.032) | −.910** (.045) |
| Time in school | .393** (.007) | .351** (.006) | .223** (.014) |
| Time in summer | .033** (.016) | .033† (.018) | .078** (.026) |
| Time in school squared | −.013** (.000) | −.009** (.000) | −.001 (.001) |
| Public school | −.040 (.029) | −.030 (.024) | −.076* (.030) |
| Kindergarten family SES | .188** (.014) | .180** (.012) | .144** (.015) |
| Repeat kindergarten | .024 (.051) | .003 (.048) | −.061 (.054) |
| Child age | .080** (.009) | .116** (.010) | .100** (.012) |
| Male | −.058* (.019) | −.020 (.018) | −.030 (.023) |
| Black | −.013 (.044) | −.150** (.034) | −.413** (.047) |
| Hispanic | −.024 (.030) | −.100** (.023) | −.253** (.035) |
| Asian | .217** (.056) | .076† (.044) | −.221* (.067) |
| Native American | −.157* (.066) | −.095 (.067) | .146 (.098) |
| Biracial | .064 (.054) | .001 (.051) | −.031 (.066) |
| ESL | −.122** (.033) | −.111** (.029) | −.353** (.043) |
| Immigrant parent | .044 (.030) | .045† (.025) | −.118** (.033) |
| Parent separated | −.126** (.028) | −.101** (.025) | −.028 (.036) |
| Parent single | −.035 (.029) | −.040 (.026) | .006 (.037) |
| Northeast | −.158** (.041) | −.064† (.036) | −.016 (.052) |
| Midwest | −.059† (.033) | −.002 (.032) | .035 (.034) |
| West | −.079* (.031) | −.055* (.027) | .032 (.034) |
| Parent age | .011 (.010) | .017† (.009) | .036* (.013) |
| Number of siblings | −.053** (.010) | −.037** (.009) | −.052** (.011) |
| School slope on | | | |
| Cumulative family SES | .000 (.002) | .000 (.002) | .010* (.004) |
| Child age | −.009** (.002) | −.010** (.002) | −.006* (.003) |
| Repeat grade | −.078** (.011) | −.046** (.010) | −.047** (.013) |
| Male | −.007* (.003) | .010* (.003) | .011* (.006) |
| Black | −.029** (.007) | −.037** (.006) | −.002 (.011) |
| Hispanic | −.012* (.006) | −.003 (.005) | −.008 (.009) |
| Asian | −.022* (.007) | .003 (.008) | .020 (.015) |
| Native American | .000 (.013) | .014 (.011) | −.032 (.028) |
| Biracial | .002 (.009) | −.009 (.010) | −.002 (.017) |
| ESL | −.015* (.006) | .017* (.005) | .016 (.011) |
| Immigrant parent | −.003 (.005) | −.012* (.005) | .020* (.008) |
| Parent separated | .018* (.005) | .003 (.005) | −.001 (.009) |
| Parent single | −.009 (.006) | −.008 (.005) | −.016 (.010) |
| Northeast | .033** (.007) | .008 (.007) | .013 (.010) |
| Midwest | .012† (.006) | .004 (.006) | −.009 (.009) |
| West | .015* (.006) | .006 (.006) | −.012 (.009) |
| Parent age | −.004* (.002) | −.002 (.002) | −.006* (.003) |
| Number of siblings | .000 (.002) | .002 (.002) | −.003 (.003) |
| Summer slope on | | | |
| Cumulative family SES | .009 (.008) | .023* (.009) | .022† (.012) |
| Child age | .003 (.006) | .003 (.007) | .019† (.011) |
| Repeat grade | .079* (.026) | −.031 (.032) | .016 (.042) |
| Male | −.015 (.012) | .008 (.012) | .003 (.018) |
| Black | .070* (.025) | .009 (.025) | −.046 (.037) |
| Hispanic | .022 (.019) | −.062* (.021) | −.002 (.030) |
| Asian | .059* (.028) | −.009 (.030) | .030 (.053) |
| Native American | .021 (.034) | −.053 (.030) | .041 (.074) |
| Biracial | −.009 (.030) | .002 (.034) | .007 (.055) |
| ESL | .044† (.023) | −.054* (.023) | −.035 (.038) |
| Immigrant parent | .002 (.017) | .053* (.019) | −.019 (.030) |
| Parent separated | −.066* (.019) | −.005 (.019) | −.012 (.031) |
| Parent single | .011 (.019) | .013 (.020) | .041 (.034) |
| Northeast | −.042† (.025) | −.028 (.026) | −.063† (.037) |
| Midwest | .010 (.020) | .055* (.023) | .060* (.029) |
| West | −.017 (.021) | .033 (.022) | .040 (.028) |
| Parent age | .009 (.006) | −.004 (.007) | .022* (.011) |
| Number of siblings | −.002 (.006) | −.007 (.006) | .000 (.010) |

*Note*. Time was measured in 3-month increments. SES = socioeconomic status; ESL = English as a second language.
† $p < .10$. * $p < .05$. ** $p < .001$.

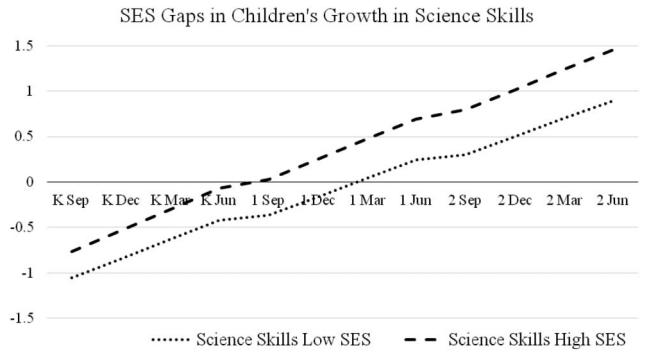


*Figure 3.* Socioeconomic status (SES) disparities in children's growth in science skills from kindergarten through second grade. Values presented in standardized units. Low and high SES represented by 1 *SD* below and 1 *SD* above the mean. Data derived from the restricted use Early Childhood Longitudinal Study-Kindergarten Class of 2010–2011 (ECLS-K: 2011) data waves 1–6 provided by the National Center for Education Statistics, U.S. Department of Education.

## Discussion

In recent decades, American parents' efforts to promote their children's life chances through provision of enriching learning opportunities have expanded in the midst of rising income inequality and increasing returns to educational attainment and social capital (Bradbury & Triest, 2016). These increases in parental investments are driven primarily by more socioeconomically advantaged families (Coley et al., 2016; Kalil et al., 2012; Kornrich & Furstenberg, 2013), and as such are hypothesized to be a primary driver of robust SES disparities in children's achievement (Reardon, 2011; Reardon & Portilla, 2016). And yet prior research has provided limited evidence of how disparities in parental investments are associated with shifts in children's academic skills through the first years of formal schooling. Providing such evidence was the primary goal of the current study, with a particular focus on assessing whether parental investments might help to explain the summer setback—that is, the pattern in which more advantaged children's academic skills continue to increase during summer months while lower SES children's skills stagnate.

Using the most recent nationally representative data on children's achievement and family contexts drawn from the ECLS-K: 2011, our results found significant growth across academic domains from kindergarten entry through second grade, with children's skills growing far faster during school months than during summer months across all learning domains, although significant small increases in reading, math, and science skills were apparent during summer months. Future research might assess whether different schooling calendars, such as year-round schools, mitigate this slowed learning during summer months. This pattern contrasts with some older work indicating declines in math knowledge during summer months and mixed findings with regards to children's maintenance of reading skills (reviewed in Cooper et al., 1996). It is possible that increases in parental investments in children's academic growth through both family and community activities over recent decades has resulted in greater growth in academic skills during the summer months. Interestingly, children's growth in reading and math skills were much larger than their growth in science skills during the school year, whereas summer growth was larger in the domain of science than in reading and math. These patterns may reflect the limited focus on science lessons in early elementary school and the importance of out-of-school activities for this domain. There has been limited work studying seasonal differences in elementary science growth, indicating this may be an important area for future study.

In considering the role of family SES in temporal gaps in children's academic skills growth, we found significant but modestly sized SES gaps in children's reading, math, and science skills at kindergarten entry. Adjusting for child and family demographic characteristics, each *SD* difference in family SES was associated with a .14 *SD* to .19 *SD* gap in children's academic skills across domain. These effects were about 25–50% smaller than unadjusted differences, highlighting the important role that associated child and family characteristics, such as child race/ethnicity or parental age and marital status, may play in explaining SES gaps in children's achievement. Although other research comparing kindergarten entry skills gaps in the 1998–99 and 2010–11 cohorts of the ECLS-K found declines in income achievement gaps in the past decade (Reardon & Portilla, 2016), these disparities nonetheless remain substantial, raising equity concerns and highlighting the need for continued efforts to support access to enriching resources and skill development during early childhood for economically disadvantaged children.

A primary contribution of the current study was our careful mapping of how these initial SES achievement gaps shifted through the first 3 years of elementary school, and whether patterns replicated the summer learning gap identified in earlier studies. Results found that the initial SES gaps in children's math and science skills grew in the first 3 years of elementary school, with small increases in SES science skills gaps during the school year, and in math skills gaps during the summer months. SES gaps in reading skills, in contrast, remained stable. Although the effect sizes of the rising SES gaps were very small, ranging from .01 to .02 *SD* units per 3 months of exposure, extrapolating these effects cumulatively from the start of kindergarten through second grade leads to a nearly doubling of the SES gap in science skills that was apparent at kindergarten entry (see Figure 3), and a 25% increase in the kindergarten entry SES gap in math skills. As a comparison, both effect sizes related to cumulative SES were about half the size of the growing science and math skills gaps between children from immigrant parent families versus those from native-born parents.

It is difficult to compare the size of these growing SES gaps over the initial school years and summer to prior research because of differences in methodology and sampling. Using the most comparative study available, our effect sizes appear comparable to those reported by McCoach and colleagues (2006) in research using the ECLS-K: 1999, although they emerged in different domains. Using relatively similar methodology but focusing only on reading skills, these authors found links between SES and reading skill gains during kindergarten of approximately .004 *SD* (with even smaller and nonsignificant effects during first grade), and links between SES and summer gains in reading skills of about .04 *SD*. Given the lack of attention to science skills in earlier research on school year versus summer skill gains, it is unclear whether the pattern we identified of increasing school year SES gaps in science skills is a continuing phenomenon or has emerged in recent cohorts, perhaps due to changes driven by increases in

Table 6
*Multilevel Path Model Predicting Academic Skills Growth Through SES and Investments*

| Outcomes and predictors | Reading skills B (*SE*) | Math skills B (*SE*) | Science skills B (*SE*) |
|---|---|---|---|
| Academic outcome on[a] | | | |
| Intercept | −1.285** (.037) | −1.258** (.032) | −.907** (.045) |
| Time in school | .394** (.007) | .351** (.006) | .218** (.014) |
| Time in summer | .029† (.016) | .031† (.018) | .076* (.026) |
| Time in school squared | −.013** (.000) | −.009** (.000) | −.001 (.001) |
| Kindergarten family SES | .188** (.014) | .180** (.012) | .144** (.015) |
| School slope on[b] | | | |
| Cumulative family SES | .000 (.002) | .000 (.002) | .010* (.004) |
| School home learning activities | .000 (.001) | .000 (.001) | .005* (.002) |
| School TV/video time | −.001 (.001) | −.001 (.001) | .001 (.002) |
| School out-of-home enrichment | .001 (.001) | −.001 (.001) | .003† (.002) |
| Summer slope on[b] | | | |
| Cumulative family SES | .008 (.008) | .019* (.009) | .012 (.013) |
| Summer home learning activities | .014* (.004) | .006 (.004) | .010 (.007) |
| Summer TV/video time | .011* (.004) | .006 (.004) | .011† (.006) |
| Summer out-of-home enrichment | .005 (.005) | .012* (.005) | .029** (.007) |
| Summer time in camp/child care | −.002 (.004) | .003 (.003) | .003 (.006) |
| School home learning activities on SES | .222** (.018) | .222** (.018) | .222** (.018) |
| School TV/video time on SES | −.273** (.018) | −.273** (.018) | −.273** (.018) |
| School out-of-home enrichment on SES | .235** (.018) | .235** (.018) | .235** (.018) |
| Summer home learning activities on SES | .180** (.018) | .180** (.018) | .180** (.018) |
| Summer TV/video time on SES | −.221** (.017) | −.221** (.017) | −.221** (.017) |
| Summer out-of-home enrichment on SES | .451** (.018) | .451** (.018) | .451** (.018) |
| Summer time in camp/child care on SES | .181** (.017) | .181** (.017) | .181** (.017) |
| Indirect effects | | | |
| SES > Home learning activities > School slope | .000 (.000) | .000 (.000) | .001* (.000) |
| SES > TV/video time > School slope | .000 (.000) | .000 (.000) | .000 (.001) |
| SES > Out-of-home enrichment > School slope | .000 (.000) | .000 (.000) | .001† (.000) |
| SES > Home learning activities > Summer slope | .002* (.001) | .001 (.001) | .002 (.001) |
| SES > TV/video time > Summer slope | −.002* (.001) | −.001 (.001) | −.002† (.001) |
| SES > Out-of-home enrichment > Summer slope | .002 (.002) | .005* (.002) | .013** (.003) |
| SES > Time in camp/child care > Summer slope | .000 (.001) | .001 (.001) | .000 (.001) |

*Note*. Time was measured in 3-month increments. SES = socioeconomic status.
[a] This path includes the following covariates: child repeated kindergarten, child gender, child race, child English as a second language (ESL) status, child age, parent age, parent marital status, family immigrant status, number of siblings in household, region, and school type. [b] This path includes the following covariates: child repeated a grade, child gender, child race, child ESL status, child age, parent age, parent marital status, family immigrant status, number of siblings in household, and region. Data derived from the restricted use Early Childhood Longitudinal Study-Kindergarten Class of 2010–2011 (ECLS-K: 2011) data waves 1–6 provided by the National Center for Education Statistics, U.S. Department of Education.
† $p < .10$. * $p < .05$. ** $p < .001$.

charter schools (U.S. Department of Education, National Center for Education Statistics, 2018) or enhanced curriculum and assessment efforts (ASCD and Education Policy, 2018), often focused on STEM learning. Measurement limitations may also be important, as there has been less prior attention to validating measures of early science skills.

In seeking to identify potential explanations for these increasing academic skills gaps across the first years of formal schooling, we focused on the role of parental investments both in and outside of children's homes. Results unearthed robust evidence of SES disparities in parental investments, with higher SES children exposed to greater reading-based home learning activities, greater out-of-home enrichment activities, and less TV/video time during both the school year and summer months, as well as to more time in summer camp/childcare programs. SES disparities in summer out-of-home enrichment activities, such as trips to libraries, museums, zoos, or plays were particularly notable, with differences of nearly ½ a standard deviation. These enrichment activity disparities in turn predicted summer growth in children's math and science skills, leading to significant, albeit very small, indirect effects. The connection between such activities and children's gains in math and science, but not reading skills, may reflect the role of cultural resources such as zoos and museums in promoting young children's STEM learning and encouraging parental engagement in early math and science activities (Bell, Lewenstein, Shouse, & Feder, 2009; Burkam et al., 2004). Home learning activities also served as a connector between SES and children's gains in science skills during the school year, a particularly interesting finding because the home learning activities assessed here were focused on reading and not on other activities that might appear to be more clearly connected to science. Although efforts to increase parental investments in young children's math skills has gained significant research attention in recent years (DREME Network, 2019), there is very limited data on young children's science skills or the inputs

that promote achievement and interest in science from a young age (Betancur, Votruba-Drzal, & Schunn, 2018), an important avenue for future research.

In contrast to the growing SES disparities in children's early math and science skills, our results found that SES gaps in reading skills remained stable across the early years of school. These results are in contrast to similar analyses with the 1998–99 ECLS-K (McCoach et al., 2006), and may reflect the notable focus on early literacy in recent years, and enhanced efforts to promote book reading and other literacy activities among economically disadvantaged families through programs such as Raising a Reader (Anthony, Williams, Zhang, Landry, & Dunkelberger, 2014).

Surprisingly, the null results of shifts in SES gaps in reading that emerged in the current study hid diverging patterns across indirect paths. Whereas SES was positively associated with summer growth in reading skills through enhanced reading-based home learning activities, a similar-sized negative path emerged running through TV/video time. This later path ran counter to the bivariate correlations between TV/video and children's reading skills, which showed the expected negative direction, with additional exploratory analyses suggesting that this indirect path emerged once models were adjusted for other parental investments. Other recent research on TV viewing has reported mixed results in connections between TV time and reading skills or time in enriching activities (Bittman, Rutherford, Brown, & Unsworth, 2011; Chin & Phillips, 2004; Zimmerman & Christakis, 2005). Given the vast expanse of media options now available, including a rich array of educationally focused children's products (Bittman et al., 2011), it is possible that children were exposed to media products that promoted literacy activities or skills. These results suggest the need for further attention to the role of media on young children's learning, including new media not assessed in the current study such as social media platforms and gaming systems, and to how interconnections between different types of family investments best promote children's achievement.

## Limitations

Indeed, these results highlight one of the key limitations of this study: the lack of information on the quality of children's learning investments across contexts. Our measures of home and out-of-home activities assessed the frequency of exposure, but were not able to capture either other aspects of intensity (such as the length of exposure), nor the quality of children's experiences, reflecting factors such as the developmental appropriateness of the materials, adult engagement, or incorporation of new concepts into other activities. The measures of learning investments, which contained small numbers of questions assessing a somewhat narrow range of behaviors, also likely missed many additional learning experiences of children, such as home math or science-related activities and afterschool activities and programs. If the breadth and quality of learning experiences also varied across SES, these omissions identify a potential explanation for unexplained variance in the SES gaps discovered in this research. Moreover, although this study assessed SES gaps in children's learning activities, we did not address whether children's exposure to such activities varied across other key dimensions, such as race/ethnicity. Cultural differences in families' provision of early learning experiences for children remain a key topic of import to address in future research. Prior research, for example, has found ethnic differences in the frequency but not the consequences of parental learning inputs such as reading together. Sims and Coley (2016) found that English-speaking White and Chinese mothers engaged in more book reading with their young children than did English- or Spanish-speaking Mexican or Chinese-speaking Chinese mothers, although greater frequency of book reading was similarly associated with enhanced early reading skills among children across all cultural and language groups. Similarly, Koury and Votruba-Drzal (2014) found sizable mean differences in observed and parent-reported measures of cognitive stimulation in the home environment across various native and immigrant ethnic groups in the ECLS-K: 1998; however, these measures were similarly related to children's academic skills. However, studies such as this may miss key learning activities, such as storytelling or attending cultural events, which are more common and may hold particular relevance for some nondominant cultural groups. Further work is necessary to identify learning activities that have been omitted in prior research, to develop and validate more inclusive and culturally diverse measures, and to more fully explore how children's exposure to a diverse array of early learning environments varies across key demographic populations to identify groups at heightened need of additional supports.

It is also important to highlight other limitations of this research. The dated system of rating parental occupational prestige, for example, may have miscategorized jobs due to macroeconomic and cultural shifts in employment opportunities and prestige. Another limitation was our inability to follow children past second grade, due to the transition of the ECLS-K to annual data collection after this grade. Finally, it is essentially to highlight the correlational nature of the data and hence our inability to identify causal effects of family SES or children's learning experiences on their academic success.

## Summary

Although extensive policy and practice attention has been directed at increasing socioeconomically disadvantaged children's academic achievement in recent decades, this study reiterates the continued sizable SES gaps in young children's key academic skills. Research by Reardon and Portilla (2016) comparing data from the 1998–99 and 2010–11 cohorts of the ECLS-K found small declines in income gaps in kindergarten entry reading and math skills. Still, unadjusted gaps between children at the 90th versus 10th income percentile remained very large, over 1 *SD* (Reardon & Portilla, 2016). These substantial SES gaps in children's skills at kindergarten entry highlight the importance of the early childhood period in setting children on trajectories of success, and the challenges faced by schools as they seek to optimize all children's skills and serve as an equalizing force for disadvantaged children (Alexander et al., 2007).

Dynamic complementarity and self-productivity models argue that early skills and early investments, respectively, improve children's capacity to expand their skills and benefit from future investments (Cunha & Heckman, 2007). Such models suggest that early skill and resource deficits will be compounded over time and will expand through later childhood. Our results suggest that this indeed appears to be the case, particularly within the domains of math and science where skills gaps continued to grow over sum-

mer and school periods, respectively, after kindergarten entry. Further, this study found evidence that parental investments at least partially mediated these growing achievement gaps, indicating that the enriching out-of-school experiences children are exposed to have significant consequences for academic growth.

The results of this study suggest that the "equalizing" efforts of primary and secondary schools (Alexander et al., 2007) are fighting an uphill battle, potentially exacerbated by inequalities in school contexts from funding (Jackson et al., 2015), teacher quality (Chetty et al., 2014), and peer skills (Sacerdote, 2011), which may further inhibit disadvantaged children's educational progress. These disparities reinforce the need for continued efforts to enhance investments in low-SES children and expand their opportunities for enriching year-round learning opportunities across home, school, and community contexts.



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