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Abstract

This study examined the third-grade outcomes of 11,902 low-income, Latino children who experienced public school pre-K or childcare via subsidies (center-based care) at age 4 in Miami-Dade County, Florida. Regression and propensity score analyses revealed that children who experienced public school pre-K earned higher scores on standardized assessments of math and reading in third-grade and had higher grade point averages than those who attended center-based care four years earlier. The sustained associations between public school pre-K (vs. center-based care) and third-grade outcomes were mediated by children's kindergarten-entry pre-academic and social-behavioral skills, and, among English-language learners, English proficiency. Implications for investing in early childhood programs to assist with the school readiness of young, Latino children in poverty are discussed.

Keywords: public school pre-K; center-based care; family childcare; Latino; third-grade; sustained effects

Differential Third Grade Outcomes Associated with Attending Publicly Funded Preschool Programs
for Low-Income, Latino Children

Quality early education programs hold great promise for facilitating the early learning of young children, with emerging evidence suggesting that interventions focusing on the early years hold greater promise than later investments (Heckman, 2008). Yet, the enrollment of Latino children in large-scale programs remains relatively low, with six in ten not attending preschool the year before kindergarten (Child Trends, 2012). With the increased emphasis on the acquisition of the foundational skills necessary for school success, early education programs have received increased interest from policy makers, researchers, educators, and parents as one means of narrowing the school readiness gap between Latino children and their White peers, which some estimate is as large as 52-77% of a standard deviation (Reardon & Galindo, 2009).

Despite the wealth of research on children's early school experiences, the few existing long-term evaluations of model programs have *not* included Latino children (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; Schweinhart et al., 2005). Just as importantly, much of what is known about the Latino population is limited to Mexican-American children and families (Crosnoe, 2007) and does not generalize to the Latino population in the U.S. more broadly. This lack of knowledge is concerning when one considers that early education programs are often the first time Latino children are immersed in U.S. culture (Garcia & Jensen, 2009) and the English language (American Community Survey, 2012). Thus, early education programs serve as a critical leverage point for establishing Latino children's educational trajectories.

To address these gaps in knowledge, we report on the associations between low-income, Latino children's participation in large-scale, publicly funded preschool programs and their third grade academic outcomes using data from the Miami School Readiness Project (MSRP; Winsler et al., 2008). We focus on two of the more commonly used publicly funded programs: (a) public

school pre-K programs sponsored by school districts, and (b) subsidized center-based care including non-Head Start programs that span across local and national chains. Although there are other important options that may fit the needs of Latino families (parental care, relative care, family childcare, Head Start), these arrangements are beyond the scope of our study because data on these programs were not available. As part of this study, we also consider *why* these programs may affect later achievement by focusing on children's school readiness.

It is important to note that our objective is *not* to determine whether certain preschool programs are more (or less) effective for Latino children as compared with children of other cultural backgrounds. Such a comparison has been documented in the extant literature (Bloom & Weiland, 2015; Crosnoe, 2007; Weiland & Yoshikawa, 2013) and is beyond the scope of the data we have available. Rather, given the limited evidence about the long-term effects of publicly funded preschool programs for this population, the central question for this study is whether public investments in preschool education are sustained through third grade for low-income Latino children living in the Miami-Dade community. Thus, this study can provide descriptive evidence for differential third grade outcomes associated with attending publicly funded preschool programs for a rapidly growing portion of the population in the U.S.

Sustained Benefits of Large-Scale Early Education Programs

Viewing early education programs as a form of human capital investment is not new. Indeed, small-scale experimental programs (Perry Preschool, Abecedarian Project) from the 1960s and 1970s have confirmed that early investments can promote the long-term success of children (Campbell et al., 2002; Schweinhart et al., 2005). Unfortunately, it is difficult to extract policy implications from these model programs because, when taken to scale in recent years, the benefits of early education programs have not matched those of Perry Preschool or the Abecedarian Project (Duncan & Magnuson, 2014). Evaluations of large-scale and publicly

funded preschool programs suggest that there are immediate benefits for children's academic skills, and, to a lesser extent, their social-behavioral development (Forry, Davis, & Welti, 2013; Gormley, Gayer, Phillips, & Dawson, 2005; Grindal & López, 2014; Manfra, Dinehart, & Sembante, 2014; Weiland & Yoshikawa, 2013; Winsler et al., 2008), and these benefits extend to Latino children (Ansari & Winsler, 2012; Bloom & Weiland, 2015; Bumgarner & Brooks-Gunn, 2015; Crosnoe, 2007). Most studies exploring the benefits of preschool education, however, do not examine benefits beyond the program year.

Prior research examining the long-term outcomes of early care and education programs has often uncovered a phenomenon known as "fadeout," whereby the initial advantages conferred by early education programs appear to diminish as children, both Latino and not, progress through elementary school (Bloom & Weiland, 2015; Hill, Gormley, & Adelstein, 2015; Lipsey et al., 2015; Magnuson et al., 2007; Puma et al., 2012). Although there is not a strong consensus as to why these differences fade out, there are various hypotheses. Some scholars suggest that this fadeout can be explained by the quality of later classroom experiences or the fact that teachers design their classroom instruction for children who are academically behind (Magnuson et al., 2007; Yoshikawa et al., 2013). Other scientists suggest that remediation services in elementary school for disadvantaged children might help them "catch up," thus, reducing the long-term benefits of preschool programs (Hill et al., 2015). Regardless of why these initial advantages fadeout, understanding whether there are sustained benefits of publicly-funded preschool programs for low-income, Latino children is imperative because once Latino children fall behind, they often stay behind (Rumberger & Anguiano, 2007).

Indeed, recent evaluations of the long-term benefits of large-scale programs, which have included Latino children, have not been as promising as short-term evaluations. In an analysis of Tulsa's public pre-K programs, Hill and colleagues (2015) found no consistent long-term

advantages through the end of third grade for the full sample of children or for Latino children. The only consistent sustained effect was for one cohort of boys and present only for math skills (not reading). This is particularly surprising considering the Tulsa's pre-K programs are one of the most promising large-scale early education services in the U.S., especially for Latino children (Gormley & Phillips, 2005). Similarly, a recent national evaluation of the federally funded Head Start program revealed that program impacts largely dissipated by the time children entered first grade (Puma et al., 2012), even among Latino children who benefited most during the program year (Bloom & Weiland, 2015). Similar patterns of fadeout have also been documented at the national level with non-Latino populations (Magnuson et al., 2007). Although these studies have provided critical insight into the potential long-term associations between publicly funded preschool programs and child development, these studies have been few and far between. Accordingly, continued work is necessary to understand whether there are sustained benefits of preschool programs, and if so, why this may be the case.

Pathways from Early Care and Education Programs to Third Grade Outcomes

Conceptual models from the economics literature suggest the benefits of human capital investments, such as preschool education, can be sustained over time because higher-level skills are based on lower-level ones developed during the early years (i.e., skills-beget-skills; Cunha et al., 2006). In other words, the skills that children bring into kindergarten have implications for their development during later periods and, therefore, if preschool programs promote children's school readiness, these programs, in turn, may be able to influence third-grade outcomes. Pulling from the literature on child development, we focus on three potential school readiness mediators: Latino children's pre-academic skills, social-behavioral skills, and early English-proficiency.

There is a rich literature documenting children's pre-academic skills as the foundation for their later school achievement (Duncan et al., 2007), with prior studies revealing that these skills

can be learned (and improved) through early education (Gormley, et al., 2005; Weiland & Yoshikawa, 2013; Winsler et al., 2008). There have been mixed findings, however, when examining children's social-behavioral skills, both as an outcome of preschool programs (Ansari & Winsler, 2012; Forry et al., 2013; Grindal & López, 2015) and as a predictor of school success (Duncan et al., 2007). Even so, these early social-behavioral skills may be particularly relevant for Latino children, who exhibit social and behavioral strengths when compared with their non-Latino peers (De Feyter & Winsler, 2009). Finally, Latino children's early English proficiency is recognized as a critical component for their school success, with several studies documenting strong associations between children's English proficiency and later reading achievement (Genesee et al., 2005; Halle et al., 2012). Thus, low-income Latino children may demonstrate long-term academic advantages as a result of preschool education to the extent that such programs promote their school readiness and English proficiency. These may, in turn, serve as potential mediators for the sustained effects of preschool programs (for a similar decomposition of early intervention effects, see: Sorensen, Dodge, & The Conduct Problems Prevention Research Group, 2015).

Publicly Funded Early Care and Education Programs Serving Latino Children

Formal preschool programs are associated with stronger school readiness skills for low-income Latino children as compared with their non-Latino peers (Crosnoe, 2007; Gormley & Phillips, 2005; Weiland & Yoshikawa, 2014), but there are important differences existing within these programs that are often obscured in larger preschool evaluations (e.g., public school pre-K vs. other center-based care; Ansari & Winsler, 2016; Grindal & López, 2014). For example, Latino children enrolled in public school pre-K programs generally demonstrate greater gains across areas of pre-academic skills (Gormley & Phillips, 2005; Weiland & Yoshikawa, 2013; Winsler et al., 2008) when compared with children in publicly funded community-based centers

or those who have yet to attend pre-K. In prior work with the MSRP, Ansari and Winsler (2016) found that low-income Latino children who attended public school pre-K entered kindergarten demonstrating stronger kindergarten readiness with effect sizes ranging from 10-23% of a standard deviation, and similar patterns have emerged in other urban communities including Los Angeles (ES = .20-.28 *SDs*; Grindal & Lopez, 2015), Tulsa (ES = .54-.59 *SDs*; Gormley & Phillips, 2005), and Boston (ES = .31-.88 *SDs*; Weiland & Yoshikawa, 2013).

These differences across public school-based and non-school-based programs may arise for many reasons, two of which include: (a) the quality of programs and (b) the selection of children into preschool. For example, public school pre-K programs are housed in public schools, have greater accountability policies, are often better aligned with the K-12 educational system (Kauerz, 2006), and are typically of higher quality (Fuligni, Hoes, Lara-Cinisomo, & Karoly, 2009) when compared with center-based care. Moreover, public school pre-K programs often have higher teacher educational requirements than non-school-based programs and these teachers spend more time engaging children in cognitively stimulating activities with a known curriculum (Phillips, Gormley, & Lowenstein, 2009). Other factors to take under consideration when trying to understand differences across programs are the processes by which families select pre-K (Coley et al., 2014). This is imperative as these factors are also associated with children's long-term functioning. These selection mechanisms cut across several domains including the supply side, the demand side, and the potential role of children themselves (Crosnoe, Purtell, Davis-Kean, Ansari & Benner, 2016). As just one example, if parents choose to invest in their children's human capital by enrolling them into pre-K as a recognition of, or reaction to, the children's cognitive abilities (see Ansari & Crosnoe, 2015), then these advantages are likely to explain some of the long-term effects of preschool education.

The Current Study

Despite strong evidence for immediate benefits of publicly funded preschool programs for Latino children, few studies have examined the effectiveness of these programs beyond the end of the preschool or kindergarten year. We use data from the MSRP—a longitudinal, cohort-sequential, university-community collaborative, school readiness project—to address these gaps in knowledge. We address the following two research questions:

1. Are there differential long-term (third grade) outcomes associated with public school pre-K and subsidized center-based care for low-income, Latino children as evidenced by their performance on standardized reading and math tests as well as end-of-year grades?
2. Do the sustained benefits of preschool education operate through children's pre-academic and social-behavioral skills, and, among English-language learners (ELLs), English proficiency?

First, we hypothesized that low-income Latino children who attended public school pre-K at age four would maintain an advantage through the end of third-grade when compared with those who attended subsidized center-based care in the community. Second, we expected that any observed long-term associations between preschool programs and third-grade academic performance would be explained, at least in part, by children's school readiness and, among ELLs, English proficiency.

Method

The MSRP represents most of the population of 4-year old children of Miami-Dade County, Florida ($n = 41,339$) who were enrolled in public school pre-K (58%) or were receiving subsidies to attend childcare in the community (center-based childcare, 42%) between the 2002 and 2006 school years. Eligibility for childcare subsidies in this community was capped at 150% of the federal poverty line (Schulman & Blank, 2011). Most children (roughly 70%) attending public school pre-K did so for free because they lived by and attended a high-poverty Title-1

school, with similar income eligibility criteria (eligibility for free lunch is capped at 130% of the federal poverty line whereas eligibility for reduced lunch is capped at 185%). The remaining low-income children attending a non-Title-1 school paid a sliding scale fee based on family income to attend the pre-K program. It is also important to note that subsidies were not provided directly to families; rather, county agencies paid the childcare programs based on billable enrollment hours (e.g., vouchers). All families of 4-year-olds receiving childcare subsidies and those attending public school pre-K each year received a consent form for their children to participate in the school readiness assessment project and longitudinal follow-up within the local public school system, which involved families receiving free child assessment reports in English or Spanish. Roughly 10% of families did not consent for their children to be participants or were not assessed at age 4 due to scheduling conflicts. The MSRP did not collect data on children who were: (a) attending Head Start, (b) being cared for exclusively by a parent, or (c) attending private childcare without subsidies (e.g., more advantaged families). By the third-grade year, however, the MSRP sample represents roughly 25-30% of the entire low-income population in Miami Dade County Public Schools (MDCPS; Department of Education, 2000-2010).

At the time, the pre-K programs in Miami were housed in MDCPS and operated for 3-4 hours a day. Between the 2002 and 2004 school years, the pre-K programs were using the High Scope curriculum, whereas starting in the 2005 school year, the school district changed to the Houghton Mifflin curriculum. Public school pre-K programs were also required to be staffed by certified teachers with a child-adult ratio of no more than 20:2. Unfortunately, comparable information was not available for center-based programs. At the time, center-based programs were of average quality (as measured by the Early Childhood Environment Rating Scale-Revised) and largely unaccredited (fewer than 10% were accredited). Further, center-based programs had roughly 16 children per teacher and, on average, children received care for 7-8

hours a day (Winsler et al., 2008). Fifty-six percent of the center-based programs were for-profit (44% not-for-profit) and 24% were faith-based (76% not faith-based).

For the purposes of this investigation, we focused on children who were identified as Latino on school enrollment forms ($n = 24,275$). We eliminated children who were classified as having special needs during preschool and attended a special pre-K program for children with disabilities ($n = 2,090$). We also excluded children who left the school system by third grade ($n = 4,645$), skipped a grade ($n = 62$), or were retained prior to third grade ($n = 2,366$). Children who were retained prior to third grade were excluded to isolate comparisons among typically developing children without social and academic confounds associated with retention. In doing so, we were able to compare our results to other recent studies that did not include children who were retained (Hill et al., 2015). Next, we limited our sample to children who experienced preschool between the 2002 through 2005 school years because only a small number of children who experienced preschool during the 2006 school year had completed school readiness assessments ($n = 2,932$). Finally, we excluded 177 children who did not take the standardized test during third grade and 101 children whose parents used their subsidies for family childcare. This resulted in a final sample of 11,902 Latino children. With these exclusion criteria in place, our final sample of children were, on average, 66 months of age and consisted of 51% females. The majority of children received free or reduced lunch (75%) and were identified by the school district as ELLs (81%) at kindergarten entry. All sample demographics are reported in Table 1.

Attrition analyses were conducted by comparing the sample of children who remained in the school district with those who left, were retained, or skipped a grade prior to third grade entry (see online Appendix Table 1). These analyses revealed that the Latino children who remained in our sample were slightly more advantaged in terms of preschool entry abilities and socio-economic status than those who were excluded from our analyses. Further, children in public

school pre-K were more likely to have remained in our sample than those in other center-based care programs. Thus, the generalizability of our findings are limited and may not be applicable to the most at-risk Latino children in the Miami-Dade community.

Measures

Pre-academic skills. Children's cognitive (matching and counting), language (comprehension and naming), and fine motor (writing and manipulation) skills were directly assessed at the beginning (pre-test, September-October) and end (post-test, April-May) of the preschool year using the Learning Accomplishment Profile Diagnostic (LAP-D; Nehring et al., 1992)—a nationally norm-referenced instrument that has strong internal consistency, both nationally ($\alpha = .76-.92$; Nehring et al., 1992) and within the larger MSRP sample ($\alpha = .93-.95$; Winsler et al., 2008). Spanish (43%) and English (57%) versions of the LAP-D were available and the assessment was administered in children's strongest language—determined by their teacher and the bilingual assessor after having interacted with them in both languages—with both versions having strong test-retest reliability ($\alpha = .93-.97$; Hardin et al., 2005). Children in public school pre-K were administered the assessment by their teachers, whereas children in subsidized childcare were administered the assessment by a MA-level trained assessors who traveled to the childcare providers. Given the strong inter-correlation among these subscales (see online Appendix Table 2 for a correlation table and descriptive statistics for each subscale), we created an overall composite of pre-academic skills ($\alpha = .78$). It is important to note that both the Spanish and English versions of the LAP-D are highly correlated with other commonly used school readiness measures (Hardin et al., 2005), including subscales from the Woodcock Johnson (Woodcock, McGrew, & Mather, 2001) and the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997), which have both been used in evaluations of pre-K programs in Boston (Weiland & Yoshikawa, 2013) and Tulsa (Gormley et al., 2005).

Children’s social-behavioral skills. Teachers reported on children’s socio-emotional and behavioral strengths at the beginning (September-October) and end (April-May) of the preschool year with the Devereux Early Childhood Assessment (DECA; Lebuffe & Naglieri, 1999), which consists of two subscales: (a) socio-emotional protective factors, and (b) behavior concerns. Teachers were asked to rate children’s behavior from the prior four weeks on a scale of 0 (*never*) to 4 (*very frequently*). Questions from the social skills subscale include: “starts or organizes play with other children,” whereas an example of a behavior concerns item is “fights with other children.” The teacher-rated DECA has strong internal consistency and has been validated with Latino children ($\alpha = .90-.94$; Crane, Mincic, & Winsler, 2011). Given the strong correlation between these two scales, we created a composite of social-behavior ($\alpha = .70$; for descriptive statistics on subscales and correlations, see online Appendix Table 2).

English proficiency. Upon kindergarten entry, children in the district received the Oral Language Proficiency Scale-Revised (OLPS-R; Abella, Urrita, & Schneiderman, 2005) when parents reported speaking a language other than English at home on the kindergarten registration form. Thus, only English-language learners (ELLs, $n = 9,695$) received assessments of English proficiency (non-ELLs were excluded from English proficiency analyses). The OLPS-R, which was administered by a specialist in English for Speakers of Other Languages (ESOL), is a 25-question grade-normed English oral proficiency test that classifies children on a scale of 1 (*beginner and requiring ESOL instruction*; raw assessment score of 4 or less) to 5 (*fully proficient*; raw assessment score of 20 or more) and is used to determine whether children need to participate in an ESOL program. Items require children to point to pictures, name items, complete sentences, state what is going on in pictures, respond to questions about pictures, and respond to story comprehension questions. The OLPS-R has strong internal consistency ($\alpha = .80-.94$; Abella, 1997).

Third grade reading and math scores. The Florida Comprehensive Assessment Test (Human Resources Research Organization & Harcourt Assessment, 2007) is a standardized achievement test used by the state of Florida to assess children's reading and math skills (in English) during third grade (range of 100-500). The Florida Comprehensive Assessment Test has strong internal consistency across all populations ($\alpha = .98$; Harcourt Assessment, 2007).

Third grade GPA. At the end of the school year, children received marks (A = 4, B = 3, C = 2, D = 1, F=0) from teachers in nine subject areas: reading, writing, language arts, math, science, social studies, art, music, and physical education. Given the strong correlations between these subject areas ($r_s = .22-.73$), we created an overall composite of third grade GPA ($\alpha = .87$).

Covariates. To reduce the possibility of spurious associations, we included a number of covariates that were drawn from school records: children's age at kindergarten entry, children's gender, children's nativity, home language during kindergarten, free or reduced lunch receipt during kindergarten, and special needs status during third grade. We used the third grade flag for special needs status because a sizable number of children who were classified as special needs in third grade were not diagnosed in kindergarten. Thus, in using the third grade variable, we allowed for the most judicious estimate. We also controlled for children's language of assessment on the LAP-D.

Recent literature reveals that children's own skills and behaviors are associated with "selection" into formal early education programs (Ansari & Crosnoe, 2015). In other words, children entering pre-K may demonstrate higher academic and behavioral skills prior to entering preschool when compared with children attending subsidized center-based or family childcare. To address such issues of selection, all models controlled for children's preschool entry pre-academic and social-behavioral skills (i.e., pre-test scores) as measured by the LAP-D and DECA. To account for the cohort-sequential design of the data, we also included dummy coded

fixed period effects. Although we did not have data on families for the children enrolled in public school pre-K, we did have household data for a 35% subsample of children who experienced childcare at ages 3 and 4. From these estimates, we were able to conclude that children who switched from subsidized childcare at age 3 to public school pre-K at age 4 did not differ from those who remained in the subsidized childcare system (Ansari & Winsler, 2013).

Analytic Strategy

We estimated two sequential models using Ordinary Least Squares (OLS) regression methods. In Model 1, we included covariates and children's childcare type to examine the association between childcare and children's third grade outcomes. Then, in Model 2, we incorporated measures of children's school readiness to test for mediation, which was confirmed using the z statistic from the Sobel test (Sobel, 1982). We first estimated models with the full sample of children controlling for home-language and, then, replicated our focal models within the ELL sub-sample because only ELLs received tests of English proficiency. A third model was conducted for the ELL sub-sample to include English proficiency as a third possible mediator.

We accounted for dependence in child outcomes by estimating cross-classified models in the Stata program. In doing so, we accounted for the fact that children from the same preschool setting may not have attended the same school in third grade and vice versa. Unfortunately, the MSRP did not have classroom-level data to account for the nesting of children within classrooms. To address missing data (0-25%), we imputed 25 datasets using the chained equations method in Stata. Note that all outcome variables in our analyses were standardized and, thus, coefficients can be interpreted as effect sizes (i.e., standard deviation units).

Results

The first aim of this study was to examine whether there were differential third grade outcomes associated with preschool participation for low-income, Latino children in the MSRP.

As can be seen across Models presented in Table 2, our OLS models revealed that Latino children who attended public school pre-K the year before kindergarten scored higher on the standardized reading ($\beta = .12, p < .001$) and math tests ($\beta = .11, p < .001$) and earned higher end-of-year grades ($\beta = .15, p < .001$) than Latino children in subsidized center-based care programs, even after accounting for children's preschool entry pre-academic and social-behavioral skills (for tabled results of covariates, see online Appendix Table 3).

Having established the long-term associations between publicly funded preschool programs and Latino children's third grade outcomes, our second goal was to determine whether the differential outcomes were explained, at least in part, by Latino children's school readiness. Preliminary analyses (available upon request) established that children in public school pre-K programs demonstrated greater pre-academic ($\beta = .43, p < .001$) and social-behavioral skills ($\beta = .25, p < .001$) at the end of the preschool year as compared with children in center-based care. Thus, both of these measures met the initial requirements for mediation.

After including measures of school readiness in our models, we found that both Latino children's pre-academic and social-behavioral skills were independently associated with their third-grade academic performance (for effect sizes, see Model 2 of Table 2). Notably, the difference in Latino children's performance on the third-grade reading test between public school pre-K programs and center-based care was largely attenuated. Sobel tests confirmed that both pre-academic skills ($z = 12.16, p < .001$) and social-behavioral skills ($z = 3.61, p < .001$) mediated the link between public school pre-K attendance and children's performance on the reading test. Similar patterns emerged for children's performance on the math portion of the test ($z_{academic\ skills} = 12.31; z_{social\ behavior} = 3.61; ps < .001$) and their end-of-year GPA ($z_{academic\ skills} = 12.01; z_{social\ behavior} = 6.11; ps < .001$). Thus, public school pre-K programs were associated with Latino children's third grade outcomes, in large part because these children entered school more

ready to learn. Of the two mediators, however, low-income Latino children's pre-academic skills were by far the stronger mediator of the long-run associations between pre-K programs and their third grade academic outcomes (Academic: $\beta_{indirect} = .09-.10$ versus Social: $\beta_{indirect} = .01-.02$).

English Language Learner's English Proficiency as a Mediator

When we stratified our sample by ELL ($n = 9,695$) and non-ELL ($n = 2,207$) status, we found similar associations between public school pre-K programs (versus center-based care) and children's third-grade outcomes as reported in the full Latino sample (results available upon request). Thus, there was no evidence for differential effects of preschool education for Latino children who were or were not ELLs. Recall that measures of children's English proficiency were only collected for children who were from Spanish-speaking homes and considered to be ELLs by the school district. Within this ELL subgroup of Latino children, we found that those who had attended public school pre-K entered kindergarten with stronger English proficiency than their ELL peers in subsidized childcare centers ($\beta = .16, p < .01$), even when controlling for their preschool entry skills as well as their preschool language of assessment. Thus, English proficiency was included as a third possible mediator.

As shown in Table 2, ELL's English proficiency was associated with each domain of academic achievement (for effect sizes, see Model 2 of Table 2). Furthermore, ELL children's pre-academic skills and social-behavioral skills were also predictive of third-grade outcomes and comparable to the estimates reported from the full sample (results available upon request). Sobel tests confirmed that ELL's English proficiency also partially explained long-term associations between public school pre-K attendance and third grade performance on each of the academic achievement domains ($\beta_{indirect} = .02-.03, z_s = 3.82-3.91, p_s < .01$). Thus, ELL children who attended public school pre-K (versus center-based care) were more likely to succeed in third grade in part because they entered kindergarten with stronger English proficiency.

Robustness Checks

A large body of evidence shows that a variety of family characteristics, such as income, parental education, parental country of birth, and marital status predict children's short-term developmental outcomes (Magnuson, 2007) and their selection into early care and education programs (Coley et al., 2014; Crosnoe et al., 2016). This suggests these variables might explain some of the long-term associations between children's preschool arrangement and their academic outcomes in third grade. That is, it could be that early education programs would *not* be associated with children's academic outcomes when accounting for family characteristics. Because family characteristic variables were not available for the full sample of children, we assessed the potential confounding role of family characteristics through Impact Threshold for Confounding Variables analyses (ITCV; Frank, 2000) for all statistically significant effects. ITCV analyses determine the degree to which an unknown variable would have to be correlated with both the predictor and outcome variables to negate the observed associations (e.g., pre-K and third grade test performance). The equation for ITCV is: $r_{xy} - r_{xy}^{\#} / 1 - r_{xy}^{\#}$, where $r_{xy}^{\#} = t / \text{SQRT}[(n - q - 1) + t^2]$, t is the critical t -value, n is the sample size, and q refers to the number of model parameters. When covariates are included, the equation becomes $\text{ITCV}_{\text{no covariates}} \times [\text{SQRT}(1 - R^2_{xg})(1 - R^2_{yg})]$, where g is the set of covariates, R^2_{xg} is the R^2 value from a regression predicting the focal independent variable by the covariates, and R^2_{yg} is the R^2 value from a regression predicting the outcome by the covariates. Thus, in conducting ITCV, we determined whether parental covariates would negate the aforementioned associations.

Results from these analyses revealed that the documented associations between public school pre-K (versus center-based care) and children's third grade reading performance (ITCV = .10), math performance (ITCV = .09), and GPA (ITCV = .13) would only be negated if an unknown confound correlated with *both* pre-K enrollment and children's academic success in

third grade between .30 and .36. In the MSRP data, none of covariates met this benchmark for GPA (correlation range = $|.07$ to $.14|$), reading performance (correlation range = $|.05$ to $.10|$), math performance (correlation range = $|.01$ to $.12|$), or childcare selection (correlation range = $|.02$ to $.10|$). The only variable that exceeded this benchmark was children's academic skills at the end of preschool, which surpassed this threshold for pre-K attendance (correlation = $.30$) and their third grade academic performance (correlation with range = $|.28$ to $.40|$).

As a final robustness check, we estimated propensity score matching (PSM) models, which have been recognized as a strong method for controlling selection on observable factors (Rosenbaum & Rubin, 1983). For our matching models, we used the nearest neighbor method (with four matches) within a caliper of $.01$ to create a high likelihood of sufficient overlap between the comparison conditions on their propensity scores. We limited our sample to those children whose propensity scores were within the area of common support and allowed for replacement. Across the 25 imputed datasets, we were able to match 81-84% of children in center-based care with 98-100% of the pre-K sample. To assess the overall quality of balance we: (a) checked the standardized mean differences for all of our covariates using the 10% benchmark for assessing balance, and (b) regressed each covariate on the indicator variable that distinguished children in the different types of preschool programs using the propensity score weight. Both sets of analyses revealed that balance was achieved (see online Appendix Table 4).

Having successfully balanced the comparison conditions, we next estimated OLS models within our matched samples. Results from these analyses revealed that the associations between children's childcare arrangement at age 4 and their third grade outcomes were comparable to the OLS estimates reported previously and remained statistically significant (see online Appendix Table 5). Moreover, when we incorporated the school readiness mediators in the matched samples, the differences in third grade outcomes across preschool programs were largely

attenuated. As a final check of these associations, we estimated ITCV within the PSM samples and found similar, albeit slightly smaller, ITCV values (ITCVs = .05-.07; $r_s = .22-.27$).

Discussion

Examining the benefits of early education programs is not new, nor is recognizing that these programs may have long-term benefits for children's academic outcomes. Early education research, however, has rarely examined the long-term outcomes of large-scale publicly funded preschool programs, and those that have, have not been as promising as short-term evaluations (Hill et al., 2015; Lipsey et al., 2015; Magnuson et al., 2007; Puma et al., 2012). Further, most of the existing literature exploring publicly funded early care and education programs, especially long-term evaluations, has not included Latinos nor examined the outcomes for this important subgroup of children. In this study, we sought to determine whether: (a) large-scale early education programs were associated with Latino children's end of third grade academic outcomes; and (b) these long-term associations were explained through children's school readiness. Thus, the aim of this study was to provide insight into outcomes associated with two important types of publicly funded preschool programs within the landscape of early care and education that low-income, Latino preschoolers experience in the Miami-Dade community. Our findings support two primary messages.

First, in contrast to more recent evaluations of large-scale programs that have documented fadeout (Hill et al., 2012; Lipsey et al., 2015; Magnuson et al., 2007; Puma et al., 2012), our analysis of preschool programs in Miami-Dade County provide correlational support for the sustained benefits of early education programs for low-income, Latino children. Specifically, Latino children who experienced public school pre-K performed better throughout the third grade year on standardized tests of math and literacy and scored higher on end-of-year grades than children in subsidized center-based care, even when controlling for baseline

characteristics and preschool entry skills. Importantly, the effect size of public school pre-K participation on third grade outcomes (0.11-0.15 *SDs*) was comparable to those reported in an earlier evaluation of children's kindergarten readiness (0.10-0.23 *SDs*; Ansari & Winsler, 2016).

Why might public school pre-K programs be more effective than subsidized center-based care? It is likely the case that because public school pre-K programs are housed in public schools, they are of higher quality, have greater accountability policies, and are better aligned with the K-12 educational system than center-based care programs (Fuligni et al., 2009; Kauerz, 2006; Phillips et al., 2009). Unfortunately, the MSRP was not equipped to address these questions regarding classroom-level processes. Thus, future work needs to examine these issues to better understand *why* public school pre-K programs appear to render children more ready for school than subsidized childcare programs. Areas that require attention include: curriculum, instructional practices, teacher-child interactions, teacher credentials, school resources, and structural quality. It is also important to understand best practices for supporting the needs of Latino children, of which little is known. For these reasons, evidenced-based practices that facilitate the long-term development of Latino children deserve continued attention, including the availability of teachers who can speak the Spanish language, the integration of language and culture into the classroom, the amount of time during the day that English and Spanish instruction is provided, as well as two-way immersion approaches to education (Garcia & Jensen, 2009).

Second, we identified low-income Latino children's school readiness—especially their pre-academic skills—as important mechanisms for the sustained associations between early education programs and long-term school success. In fact, accounting for children's school readiness largely attenuated the associations between the different types of early education programs and Latino children's third-grade outcomes. In other words, low-income Latino

children who attended public school pre-K at age 4 were more likely to succeed during third grade because they entered school more ready for formal learning. Although it appears that low-income Latino children's pre-academic skills are the primary mechanism for these long-term associations—supporting the skill-begets-skill hypotheses (Cunha et al., 2006)—there are other mechanisms that should be examined, which we could not do with the MSRP data. For example, some programs may be more effective at getting parents involved and improving parenting skills, which, in turn, have implications for children's development (Gershoff, Ansari, Purtell, & Sexton, 2015). Future studies should examine such possibilities and determine the other means through which preschool programs and other early childhood interventions may influence children's long-term academic success and prevent adverse outcomes later in the life course (Sorensen et al., 2015).

As in any study, there are important limitations that need to be taken into consideration. Primarily, although we provided much needed insight into Latino children's experiences in Miami, our results are, by preference, not generalizable to Latinos in other parts of the U.S. as there is a continued need for research with non-Mexican Latino children across the country. Similarly, while we focused on a rapidly growing portion of the U.S. population, our analyses cannot speak to whether the experiences of these children are typical or unique when compared with children from other backgrounds. The children who were omitted from our sample were also somewhat more disadvantaged, and the MSRP did not collect data from children who attended Head Start or who were cared for at home, which represents a sizeable number of the low-income Latino population in the U.S. Thus, continued work is necessary to: (a) understand the experiences of the most at-risk children, some of whom who were not enrolled in mainstream preschool programs at age 4; and (b) examine the full landscape of early care and education programs serving this population of children and families.

The design of the MSRP also does not permit for causal inference. To lend confidence to our conclusions, we conducted sensitivity analyses that revealed our findings were robust to both measured and unmeasured confounds, and, importantly, we controlled for existing differences in children's preschool entry skills (Ansari & Crosnoe, 2015). These precautions reduce validity concerns associated with selection, but they do not eliminate them. Although there have been extensive debates regarding unknown confounds and "preschool selection," continued work is also necessary to understand what these mechanisms are (Crosnoe et al., 2016). Why do some Latino families select center-based versus family childcare? Why do some Latino families select public school pre-K as opposed to center-based care? Are these decisions driven by necessity, as a form of human capital investment, or do children drive these decisions? For example, if the parents in this community need greater flexibility due to their work schedules, they may opt for subsidized childcare programs that offer more flexible hours (e.g., open year round and for 10 or more hours per day) than public school pre-K programs, which are only in session during the academic year and operate for fewer hours per day. If, however, parents want to invest in their children's human capital, they may enroll their children in public school pre-K, which may offer enriched learning activities. Understanding these processes that underlie parents' selection of childcare has important policy implications and may highlight potential areas for intervention in trying to boost the enrollment of Latino children in preschool programs across the country. These selection factors can also explain and foreshadow some of the long-term associations documented in this study. For example, parents who enroll their children in pre-K, in turn, may select higher-quality elementary schools.

Finally, the quality of children's experiences in elementary school may be playing a hidden role in the developmental patterns reported herein. As just one example, elementary school processes may moderate the effects that are reported in this study such that these

documented associations may be stronger (or weaker) when coupled with professional support for teachers in elementary school (Jenkins et al., 2015) or when coupled with different levels of classroom quality or instructional support (Magnuson et al., 2007). Thus, future studies should consider the role of elementary schools in building on the skills children bring into kindergarten, or, alternatively, what elementary schools do to contribute to the “fadeout” of preschool effects.

Despite these limitations, this study provides promising descriptive evidence that public school pre-K programs in the Miami-Dade community promote academic success among low-income, Latino children through the end of third grade. The associations between public school pre-K programs and children’s third-grade outcomes were largely explained by children’s pre-academic skills and, to a lesser extent, their social-behavioral school readiness skills. Among ELLs, early English proficiency was also identified as an important mechanism for the sustained associations. Thus, policy-makers should consider continued funding for school-based early education programs, which have the potential to have both short- and long-term academic benefits for low-income, Latino children.

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Table 1.
Means, standard deviations, proportions, and preschool comparisons of sample characteristics.

Variables	Preschool arrangement at age 4		Preschool group difference
	Public school pre-K	Center-based care	
Child outcomes ^a			
Preschool entry			
Pre-academic skills	0.06 (1.03)	-0.12 (0.95)	***
Social-behavioral skills	0.08 (1.00)	-0.12 (0.99)	***
End of preschool			
Pre-academic skills	0.25 (0.97)	-0.33 (0.93)	***
Social-behavioral skills	0.16 (0.98)	-0.21 (0.99)	***
Kindergarten entry			
English proficiency	0.17 (0.84)	-0.28 (1.14)	***
Third grade			
Grade point average	0.14 (0.98)	-0.19 (1.00)	***
Math test score	0.11 (0.99)	-0.15 (0.99)	***
Reading test score	0.11 (0.99)	-0.15 (0.99)	***
Child characteristics			
Age at kindergarten entry	66.40 (3.52)	66.26 (3.47)	*
Female	0.52	0.50	*
Special needs	0.07	0.08	
Free or reduced lunch receipt	0.69	0.87	***
Spanish home language	0.82	0.81	
Spanish preschool assessment language	0.24	0.63	***
Foreign-born	0.11	0.10	
Year child attended preschool			
Cohort A: 2002-2003	0.19	0.24	***
Cohort B: 2003-2004	0.25	0.25	
Cohort C: 2004-2005	0.29	0.29	
Cohort D: 2005-2006	0.27	0.23	***
Sample size	6,919	4,983	

Notes. ^a All outcomes have been standardized and, thus, reflect standard deviational units. Proportions might not sum to 1.00 due to rounding.

*** $p < .001$. ** $p < .01$. * $p < .05$.

Table 2.
Results of regression models predicting children's third grade academic outcomes.

	Reading test		Math test		Grade point average				
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2			
Public school pre-K ^a	0.12 (0.02)	*** (0.02)	0.01	0.11 (0.02)	*** (0.02)	-0.00	0.15 (0.02)	*** (0.03)	0.04
School readiness mediators									
Pre-academic skills		0.23 (0.01)	***	0.24 (0.01)	***		0.22 (0.01)	***	
Social-behavioral skills		0.04 (0.01)	***	0.04 (0.01)	***		0.09 (0.01)	***	
English fluency ^b		0.18 (0.01)	***	0.14 (0.01)	***		0.13 (0.01)	***	
R^2	0.25	***	0.28	***	0.26	***	0.29	***	0.29

Note. ^a The referent for preschool arrangement was center-based care. ^b The English fluency mediator was only used for English language learners. All variables were standardized and, therefore, the unstandardized regression coefficients in this table correspond to effect sizes (i.e., standard-deviation units). Regression coefficients for the covariates are provided in online Appendix Table 3.

*** $p < .001$. ** $p < .01$. * $p < .05$.

Appendix Table 1.

Comparison of children who left, were retained, or skipped a grade prior to third grade entry (collectively) versus those who remained in our final sample

	Excluded	Included	Sig Diff.
Child characteristics			
Age at kindergarten entry	65.97 (3.57)	66.34 (3.50)	***
Female	0.46	0.51	***
Special needs	N/A	0.07	
Received free/reduced lunch	0.82	0.75	***
Home language (Spanish)	0.80	0.81	
Spanish preschool assessment language	0.49	0.39	***
Foreign-born	0.09	0.11	***
Preschool entry skills ^a			
Pre-academic	-0.20 (1.00)	0.11 (0.99)	***
Social-behavior	-0.19 (1.01)	0.09 (1.01)	***
Preschool type			
Public school pre-K	0.40	0.58	***
Center-based care	0.60	0.42	***
Year attended preschool			
Cohort A: 2002	0.22	0.21	
Cohort B: 2003	0.27	0.25	**
Cohort C: 2004	0.29	0.29	
Cohort D: 2005	0.21	0.25	***
Sample size	6,133	11,902	

Notes. ^a Children's preschool entry skills have been standardized and, thus, reflect standard deviational units. Proportions might not sum to 1.00 due to rounding.

*** $p < .001$.

Appendix Table 2.

Descriptives of, and correlations among, the LAP-D and DECA subscales.

	M (SD)	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. T1 Cognitive	46.24 (28.64)	—								
2. T1 Language	35.75 (27.62)	.60	—							
3. T1 Fine motor	54.93 (28.96)	.58	.47	—						
4. T1 Social skills	55.88 (27.26)	.21	.25	.20	—					
5. T1 Behavior problems	43.79 (28.42)	-.15	-.17	-.14	-.51	—				
6. T2 Cognitive	57.62 (28.81)	.56	.44	.40	.16	-.17	—			
7. T2 Language	48.26 (29.73)	.46	.58	.34	.23	-.20	.64	—		
8. T2 Fine motor	63.22 (26.03)	.39	.30	.55	.14	-.14	.55	.47	—	
9. T2 Social skills	64.16 (26.30)	.20	.24	.21	.56	-.40	.24	.29	.21	—
10. T2 Behavior problems	41.71 (28.87)	-.17	-.19	-.17	-.33	.60	-.23	-.23	-.18	-.56

Note. All correlations were significant at $p < .001$

Appendix Table 3.

Associations between the covariates from the regression models predicting children's third grade academic outcomes.

	Reading test				Math test				Grade point average			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
Covariates												
Age	0.10	***	0.14	***	0.10	***	0.14	***	0.09	***	0.12	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Female	-0.08	***	-0.10	***	-0.21	***	-0.23	***	0.16	***	0.14	***
	(0.02)		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)	
Spanish home language	0.02		0.03		0.09	***	0.10	***	0.06	**	0.07	**
	(0.02)		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)	
Spanish preschool assessment language	-0.03		-0.02		-0.01		-0.01		-0.03		-0.03	
	(0.02)		(0.02)		(0.02)		(0.02)		(0.02)		(0.03)	
Foreign-born	0.15	***	0.15	***	0.16	***	0.16	***	0.13	***	0.13	***
	(0.03)		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)	
Free or reduced lunch receipt	-0.25	***	-0.23	***	-0.26	***	-0.24	***	-0.34	***	-0.32	***
	(0.03)		(0.02)		(0.02)		(0.03)		(0.03)		(0.02)	
Special needs status	-0.59	***	-0.52	***	-0.53	***	-0.46	***	-0.53	***	-0.46	***
	(0.04)		(0.04)		(0.04)		(0.04)		(0.04)		(0.04)	
Preschool entry pre-academic skills	0.30	***	0.16	***	0.32	***	0.18	***	0.28	***	0.15	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Preschool entry social-behavioral skills	0.09	***	0.05	***	0.07	***	0.03	**	0.13	***	0.07	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Year child attended preschool												
Cohort A: 2002-2003	-0.08	**	-0.11	***	-0.18	***	-0.21	***	-0.33	***	-0.37	***
	(0.03)		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)	
Cohort B: 2003-2004	0.48	***	0.44	***	-0.51	***	-0.56	***	-0.05		-0.09	***
	(0.03)		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)	
Cohort C: 2004-2005	-0.08	***	-0.12	***	0.01		-0.03		0.02		-0.02	
	(0.02)		(0.03)		(0.03)		(0.02)		(0.03)		(0.02)	

Note. All variables were standardized and, therefore, the unstandardized regression coefficients in this table correspond to effect sizes (i.e., standard-deviation units). *** $p < .001$. ** $p < .01$. * $p < .05$.

Appendix Table 4.

Means, standard deviations, proportions, and preschool comparisons of sample characteristics before and after propensity score matching.

	Unmatched Matched	Center- based care	Public school pre-K	% bias	Sig. Diff.
Child characteristics					
Age at kindergarten entry	U	66.26	66.40	4.0	*
	M	66.30	66.40	2.9	
Female	U	0.50	0.52	4.0	*
	M	0.53	0.52	-2.1	
Special needs	U	0.08	0.07	-3.1	
	M	0.06	0.07	1.0	
Free or reduced lunch receipt	U	0.86	0.69	-41.5	***
	M	0.69	0.69	-0.3	
Spanish home language	U	0.81	0.82	1.2	
	M	0.83	0.82	-3.6	
Spanish preschool assessment language	U	0.61	0.22	-85.5	***
	M	0.23	0.22	-3.1	
Foreign-born	U	0.10	0.11	3.0	
	M	0.11	0.11	1.9	
Preschool entry skills ^a					
Pre-academic	U	-0.13	0.09	22.2	***
	M	0.09	0.09	0.6	
Social-behavior	U	-0.11	0.08	19.9	***
	M	0.09	0.08	-1.2	
Year attended preschool					
Cohort A: 2002	U	0.24	0.20	-10.5	***
	M	0.19	0.20	1.6	
Cohort B: 2003	U	0.25	0.25	0.7	
	M	0.24	0.25	1.4	
Cohort C: 2004	U	0.29	0.29	-0.8	
	M	0.30	0.29	-2.9	
Cohort D: 2005	U	0.23	0.27	10.2	***
	M	0.27	0.27	0.2	
Sample size	U	4,983	6,919		
	M	4,047-4,204	6,794-6,918		

Notes. ^a Children's preschool entry skills were standardized. Proportions might not sum to 1.00 due to rounding. *** $p < .001$. ** $p < .01$. * $p < .05$.