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Findings on Boston Prekindergarten Through Early Elementary School

This brief summarizes findings from the Sustaining the Boost project, an Institute of Education Sciences-funded study of the Boston Public Schools prekindergarten program. We extended what is known about the program in four different recent complementary studies.

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Key Findings

Among the four studies, one is a rigorous impact evaluation of the effects of BPS's prekindergarten program on a sample of children whose parents applied to oversubscribed schools and were therefore entered into a lottery.

1. For our lottery sample, there were no effects of enrolling in Boston prekindergarten on early elementary outcomes like retention, special education placement, or third grade test scores. There was a large positive effect, however, on persistence in the public schools.
2. Our lottery sample was more advantaged than other applicants to the program. We find that lottery sample findings may not generalize to all applicants.
3. The prekindergarten boost lasted in academically stronger schools.
4. There is a group of particularly disadvantaged children in Boston whose families do not apply to Boston prekindergarten, nor enroll them in any other prekindergarten program. Targeted recruitment strategies may help move these children into prekindergarten settings.

Introduction

The evidence is overwhelming that attending preschool better prepares children for kindergarten.[1] However, questions about how long the benefits of preschool persist are longstanding, dating back to the first major public investment in preschool in the U.S. – Head Start in the 1960s.[2] In studies of programs from decades ago, the test scores of preschool participants and non-participants tend to converge in the early elementary grades. But in adulthood, preschool participants outperformed non-participants on a wide range of behavioral, health, and educational outcomes into adulthood. Rigorous evidence on how long the preschool boost lasts in today's large-scale public programs and under what conditions is a work in progress.[3]

This brief summarizes findings from the *Sustaining the Boost* project, an Institute of Education Sciences-funded study of the Boston Public Schools prekindergarten program.[4] The work represents a joint effort by researchers at the University of Michigan and MDRC, conducted in partnership with the Boston Public Schools Department of Early Childhood. The Boston Public Schools prekindergarten program is widely known for its innovative model, high instructional quality, and its strong impacts on children's school readiness.[5] We extended what is known about the program in four different recent complementary studies:

Program Impacts. In the first study, we leveraged naturally occurring lotteries for over-subscribed Boston Public Schools prekindergarten program sites between 2007 and 2011. We identified 3,182 children who competed in 251 lotteries across study years – representing about 25% of all appliers to the program. We examined whether there were benefits of attending the program on important K-3 outcomes such as children's enrollment in the Boston Public Schools, special education placement, retention rates, and third grade test scores. Like other lottery-based studies in education, we examined whether our lottery sample estimates generalize to likely effects on all children who enrolled in the program, versus effects just for those who competed in an over-subscribed lottery.

Variation in Program Impacts. In the second study, using the same lottery sample, we examined how the effects of prekindergarten on important K-3 outcomes varied across schools. We also examined which school-level characteristics predicted a lasting prekindergarten boost. The goal of this study was to identify *under what conditions* the prekindergarten boost lasts into elementary school.

The "When" of Convergence. In the third study, we explored *when and how rapidly* literacy test score convergence occurs between kindergarten through third grade. To do so, we used the full set of children who applied to Boston prekindergarten in 2009-2010 or 2010-2011 and who enrolled in the Boston Public Schools in K-2.

BPS Prekindergarten Non-appliers. In the fourth study, we conducted a descriptive analysis comparing the Boston families that applied to the Boston prekindergarten program to those who did not. This study explores how programs should be targeted to reach all Boston children.

Putting it all together: Key findings across the four studies

- The lottery sample was more advantaged than the full sample of BPS prekindergarten applicants.
- For the more advantaged lottery sample, there were no program effects on retention, special education, or third-grade state standardized test scores in reading and math.
- There was a large effect of enrolling in Boston prekindergarten enrollment on children's enrollment and persistence in the Boston Public Schools from K-3.
- The counterfactual against which Boston prekindergarten was compared in our study is unusual. Most control group students who ultimately did not enroll in Boston prekindergarten enrolled in other preschool programs (88%). In recent preschool evaluations in other contexts,[6] about a third to half of the control group has attended other center-based preschool programs.
- The lottery sample differs from the full sample of applicants in their background characteristics, their other prekindergarten options, and in the K-3 schools they ultimately attended. For the full sample of children who applied to the program, enrolling in the program was correlated with small benefits on retention, special education, and third-grade state standardized test scores. However, this analysis was much less rigorous and we cannot conclude that the program caused any benefits. These findings merely suggest that our lottery sample findings may not apply to all children who enroll in the program.
- There was substantial variation in effects on children across schools on all outcomes. The most powerful predictor of a lasting prekindergarten boost was higher third-grade school test scores.
- Most of the convergence in literacy outcomes between children who attended the Boston program and those who did not occurred in kindergarten.
- Less advantaged students are less likely to apply to Boston prekindergarten. Non-appliers who do not attend an alternate prekindergarten option are particularly disadvantaged.

Research, practice, and policy implications:

- While this study is not a full test of the Boston program, our findings point to the importance of efforts to develop and test aligned prekindergarten through 3rd grade (P-3) instructional models to promote a lasting prekindergarten boost for all students. Boston has been engaged in such an effort since 2013. Researchers at MDRC, the University of Michigan, and the Harvard Graduate School of Education have partnered with the Boston Public Schools to study and evaluate this model.[7]
- More broadly, mounting evidence suggests that what happens after prekindergarten affects whether the prekindergarten boost lasts into early elementary school. At present, there are no proven aligned P-3 intervention strategies or curricula. Localities have recognized that P-3 alignment is important and have developed their own approaches, sometimes using P-3 frameworks to guide them.[8] Developing and testing P-3 intervention strategies and curricula should be a high priority for researchers and funders.
- Kindergarten in particular appears to be a "hot spot" for sustaining the prekindergarten boost. While there have been many prekindergarten curriculum trials, there have been fewer in kindergarten. Research on how to differentiate instruction in kindergarten may be particularly important, given descriptive evidence that

suggests little such differentiation occurs, despite the wide range of skills of entering kindergarteners.[9]

- There is a need for more rigorous studies of prekindergarten programs that can follow children longitudinally.[10] With the recent expansion of public prekindergarten programs in contexts that use lottery-based assignment algorithms to assign children to programs, the field is seemingly poised for additional rigorous studies of the impact of public prekindergarten on elementary school outcomes. Our lottery sample findings drive home the importance of understanding the characteristics of students in a city-based school lottery versus all students receiving the program. Also, given that most four year olds now attend some form of center-based care, future lottery studies may be better poised to compare different programs to each other than to answer the prekindergarten versus none question.
- There is also a need for research on the longitudinal effects of prekindergarten that includes richer student- and classroom-level measures than we were able to access in our present study. Our study relied on administrative data only and did not include, for example, data on children's socio-emotional skills, nor on instructional quality from P-3. Richer data are needed to pinpoint the malleable factors that can promote children's success in the early grades.
- Finally, there has been little research on families who do not apply to public prekindergarten programs when they are available. More targeted recruitment efforts may be needed to reach disadvantaged children who do not attend any prekindergarten program, especially given prior evidence that such children experience particularly large benefits on their kindergarten readiness skills.[11]

Study #1. The Effects of Enrolling in Oversubscribed Prekindergarten Programs through Third Grade

We used data from children who applied to Boston prekindergarten from 2007-2011 as a window into our central research question: What is the effect of enrolling versus not enrolling in a Boston prekindergarten program on children's enrollment and persistence in BPS grades K-3; children's risk of being retained in grade in K-2 or of being classified as special-needs in K-3; and children's third-grade state standardized test scores in mathematics and reading?

Study Design. A central challenge in estimating the effects of many educational programs is that different families select into different programs. Identifying whether a program *caused* additional student learning requires randomization – a treatment and control group that are alike except that the treatment group was given access to a program and the control group was not.

In Boston, there were not enough prekindergarten seats for all children who wanted them in 2007-2011. Families ranked their top school choices and an advanced algorithm[12] assigned children to schools. When more families wanted a

particular school than there were seats, the algorithm used a random number to decide which children would win a seat in that school. This process is akin to a coin toss in breaking a tie.

Ultimately, consistent with some other lottery-based studies, we focused on *oversubscribed first choice lotteries* in our study. We identified 3,182 children who competed in 251 lotteries across study years – representing about 25% of all appliers to the program. Our treatment-group children won a seat to their first-choice school, while our control-group children lost their first-choice lottery. We leverage the random element of children's assignment to their first-choice school as a window into the effects of the program through third grade for those who *enrolled* versus those who did not.

Key findings

- The lottery produced valid treatment and control groups. Treatment and control groups were equivalent on their demographic characteristics at baseline.
- The counterfactual against which Boston prekindergarten was compared in our study is unusual. Most control group students who ultimately did not enroll in Boston prekindergarten enrolled in other preschool programs (88%). In recent preschool evaluations in other contexts, about a third to half of the control group has attended other center-based preschools programs.
- There was a large effect of Boston prekindergarten enrollment on children's enrollment and persistence in the Boston Public Schools from K-3. For example, for consistent enrollment in the Boston Public Schools from K-3, the difference was 34 percentage points (74% versus 39%).
- There were no effects of enrolling in Boston prekindergarten on K-2 retention, K-3 special education, or third-grade state standardized reading or math test scores.
- In our analysis of the characteristics of children's K-3 schools, we found that treatment and control group students attended schools that were quite similar on average, based on the available data. Both groups of students attended elementary schools in which their peers were majority low-income and non-White and in which the majority of teachers were rated as exemplary or proficient by the state's teacher evaluation system.

To whom do our findings apply? As mentioned, we identified lotteries for about 25% of all appliers to the program. Some schools were highly over-represented and others were under-represented in the lottery sample. About half of the students in our sample competed for just 7 schools (10% of schools with prekindergarteners during this time period) and about 75% competed for just 18 schools (26% of schools with prekindergarteners during this time period). Like other lottery-based studies,[13] we examined whether our lottery sample estimates appear to represent the likely effects for all children who enrolled in the program versus effects for a more limited subset. We found:

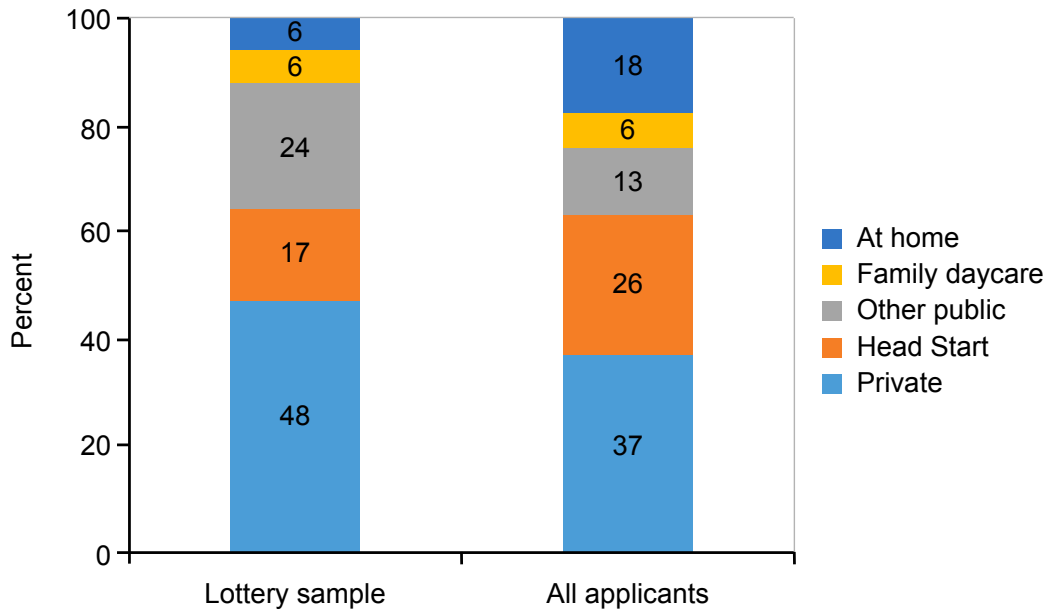
- The lottery sample was more advantaged than all BPS prekindergarten applicants. For example, 51% of lottery sample members were eligible for free-reduced lunch versus 65% of all applicants. About 28% of lottery sample members were White versus 17% of all BPS prekindergarten applicants. Further, treatment group members who enrolled in Boston prekindergarten and control group members who did not enroll scored approximately 0.4-0.5 standard deviations higher on third grade standardized tests than the average BPS third grader.
- Lottery control group children were more likely to attend other preschool programs than the full sample of applicants and the two groups also attended different program types. These differences are shown in Figure 1.

- We found that in the full applicant sample, controlling for children's background characteristics and closest neighborhood school, attending Boston prekindergarten was correlated with small benefits on retention, special education, and third-grade state standardized test scores. For example, enrolling in Boston prekindergarten was associated with a 6.5 percentage point reduction in special education placement from K-3 and with a small positive difference of 0.04 standard deviations on third grade standardized tests. This analysis was much less rigorous and we cannot conclude that the program caused these benefits.

Implications

- For families drawn to particularly popular schools – who our data show are more advantaged than all applicants to Boston's prekindergarten program – enrollment in public-school-based prekindergarten may serve as a "draw" to enrolling in and persisting in large public school systems.
- While our study is not a full test of the Boston program, our findings point to the importance of efforts to develop and test aligned prekindergarten through third grade instructional models to promote a lasting prekindergarten boost for all students. Boston has been engaged in such an effort since 2013. Researchers at MDRC, the University of Michigan, and the Harvard Graduate School of Education have partnered with the Boston Public Schools to study and evaluate this model.[14]
- Lottery-based studies have been used to study the effects of other educational programs but are just beginning to be used in prekindergarten. Our study suggests that researchers carefully consider what questions these studies can answer and to whom their estimates apply.

Figure 1: Non-BPS care settings in the year before kindergarten for lottery sample control children versus for all applicants



Study #2. The role of early elementary schools in sustaining the prekindergarten boost

Previous research has shown that the effects of preschool programs can vary significantly across schools[15] and that the quality of children's early elementary experiences may matter in sustaining the prekindergarten boost.[16] In this study, we used new methods for estimating how effects vary across schools to unpack our Study #1 findings. We first explore whether, for the sample of students who applied to oversubscribed BPS prekindergarten programs, there is variation in the effects of the Boston prekindergarten program on children's K-2 grade retention, K-3 special education placement, and third-grade state test scores. We then examine which school-level quality factors predict a more lasting boost for lottery sample members.

Study Design.

We used the same sample as in Study #1 – children who competed for oversubscribed Boston prekindergarten programs between 2007 and 2011. We used new methods for quantifying and illustrating treatment effects across sites for students' grade retention, special education identification, and third-grade ELA and mathematics achievement outcomes.[17] To estimate whether key school characteristics explain variation in impacts across schools, we used school characteristics – demand for the school; average third-grade tests scores; student growth on test scores; proportion of low-income students; and school climate – that tap into different dimensions of school quality, each measured before random assignment through the lottery process.

Key findings.

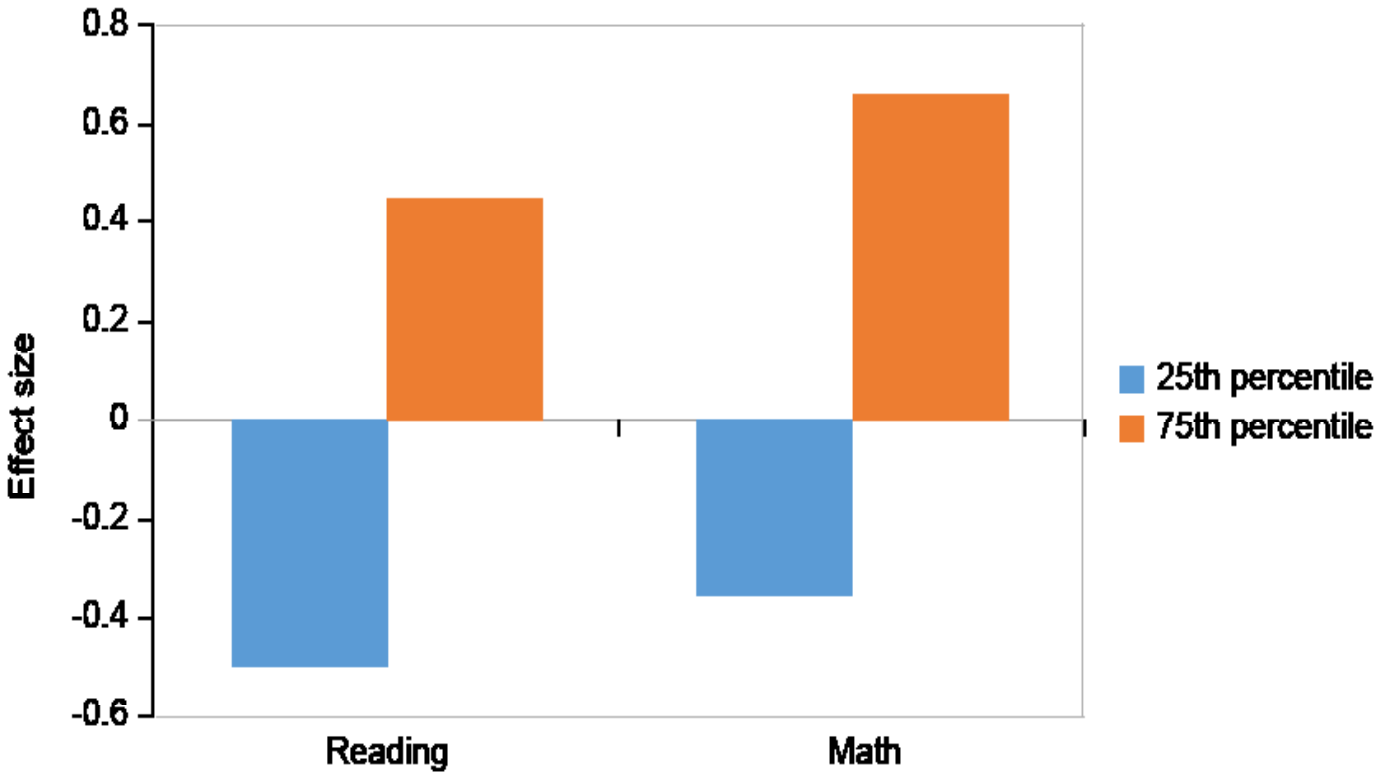
- For all outcomes, there was substantial variation in the treatment effect *across schools* that was statistically significantly different from zero. In other words, the prekindergarten boost lasted in some schools but did not last in others.
- The most powerful school-level predictor of a sustained boost was the percentage of students in the school scoring at or above proficient on third-grade state tests. For example, as we show in Figure 2, in schools scoring at the 25th percentile for the district on third-grade tests, enrolling in Boston prekindergarten lottery had a substantial negative effect on students' third grade reading and math scores (ES = -0.50 SD and ES = -0.36, respectively). But for schools at the 75th percentile, enrolling in Boston prekindergarten lottery had substantial positive effects on student's reading and math scores (ES = 0.45 and ES = 0.66, respectively).

- While most control group members enrolled in other preschool programs, the variation in impacts across schools does not appear to have been driven by this factor. The percentage of control-group children enrolled in other preschool programs was similar (and relatively high) across all schools. Variation in the prekindergarten-through-third-grade quality must be at least partially responsible for the observed variation in effects.

Implications.

- The quality of kindergarten-through-third-grade environment appears to be a key factor in determining whether or not the prekindergarten lasts through third grade. But more research is needed on the factors that predict stronger prekindergarten through third grade outcomes, particularly in schools with lower third-grade test scores.
- In Boston, K-2 curriculum alignment and teacher professional development reforms began in 2013. MDRC, the University of Michigan, and the Harvard Graduate School of Education have partnered with the Boston Public Schools to study and evaluate these reforms.[18]

Figure 2: Impacts of enrolling in Boston prekindergarten on students' third grade test scores, for students who won a seat in a school with average third grade tests scores at the 25th percentile versus the 75th percentile



Study #3. When do the literacy skills of preschool attenders and non-attenders converge?

Existing research shows that much of the convergence in tests scores between prekindergarten attenders and non-attenders occurs very early in elementary school, in kindergarten especially.[19] Using data on approximately 5,000 Boston Public School prekindergarten appliers in two of the cohorts used in studies #1 and #2, we explored this question in the Boston context.[20] We used data on children's literacy outcomes to examine *when* and *how rapidly* convergence of literacy outcomes of Boston prekindergarten enrollees and non-enrollees occurred between kindergarten and the end of third grade.

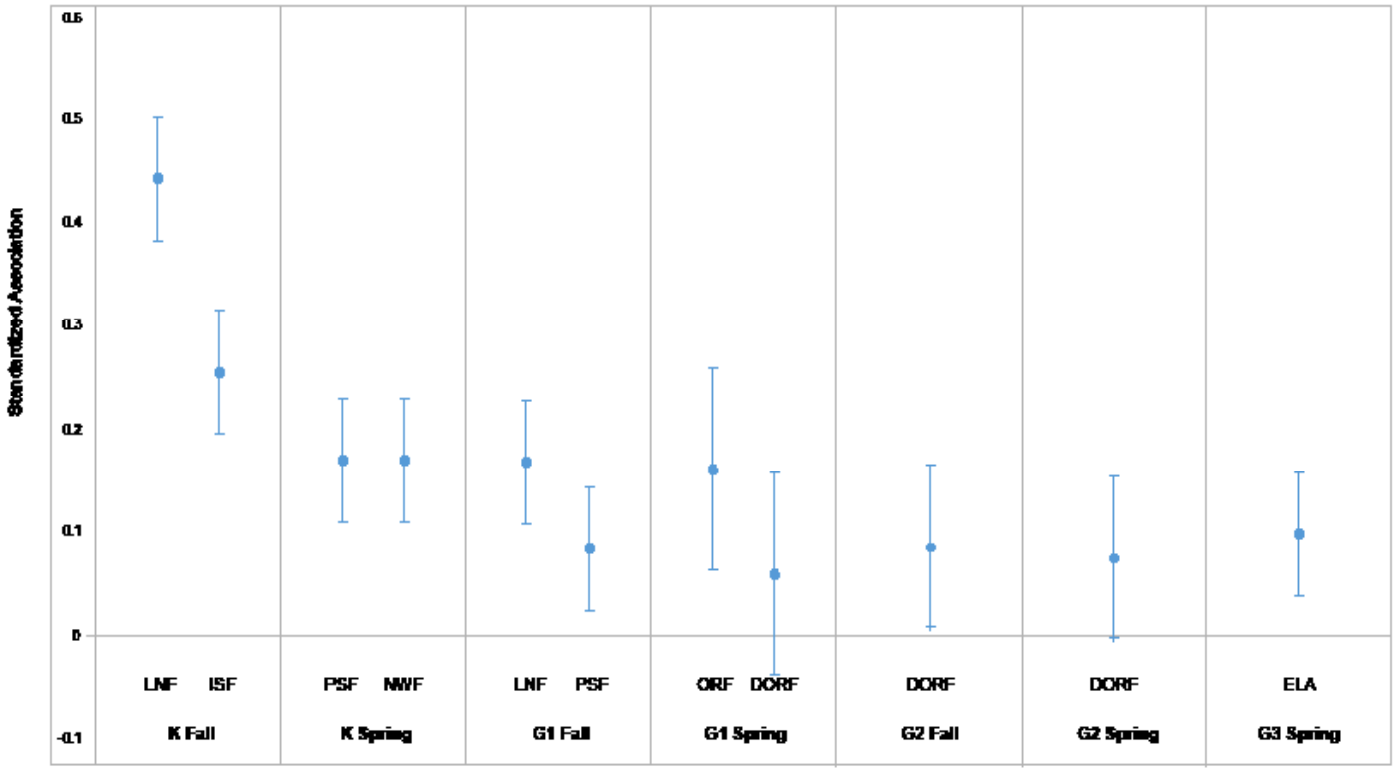
Study Design.

Our sample comes from the population of students who applied to the Boston prekindergarten program for four year olds in 2009-2010 or 2010-2011 who had at least one K-2 literacy test score and who enrolled in the Boston Public Schools for at least one grade from K-2 (approximately 81% of the full sample of appliers). We used teacher-collected data on 11 different tests of children's K-2 literacy skills from the beginning and end of each grade K-2, as well as children's third grade standardized test scores. To examine the *when* of convergence, we used a statistical approach called propensity scores to create more comparable groups of students who enrolled in the Boston program or did not enroll. We then estimated the *association* between enrolling in the program versus not at each grade level from K-3. This study design does not allow us to conclude that the program *caused* differences in students' literacy skills but does provide suggestive evidence on the *when and how rapidly* question.

Key Findings.

- As shown in Figure 3, attending Boston prekindergarten was positively associated with stronger literacy scores at every time point from K-3. At kindergarten entry, the association was 0.45 standard deviations on one test (letter naming fluency) and 0.25 standard deviations on another (initial sound fluency). By the end of kindergarten, the association was approximately 0.17 standard deviations. By third grade, the association was 0.10 standard deviations on the third-grade state standardized reading test.
- Consistent with research on other prekindergarten programs, most of the test-score convergence in our full sample appears to have occurred during the kindergarten year.
- Most children who do not attend Boston prekindergarten enroll in other preschool programs. In the two prior cohorts, 76% of prekindergarten non-enrollees attended another center-based program and only 18% were home with family members.

Figure 3: Associations between BPS prekindergarten enrollment and children's K-2 literacy scores and grade 3 standardized test scores



Note: LNF = Letter Naming Fluency ISF = Initial Sound Fluency PSF = Phoneme Segmentation Fluency NWF = Nonsense Word Fluency ORF = Oral Reading Fluency (DIBELS 6th Edition) DORF = Oral Reading Fluency (DIBELS NEXT) ELA = MCAS/PARCC English Language Arts Math = MCAS/PARCC Math

Grade 1 Spring models were fit separately for cohorts 3 and 4 because the ORF and DORF subjects are not equatable (cohort 3 took the ORF and cohort 4, the DORF in grade 1). ELA models were restricted to children who had at least one non-missing DIBELS subtest score. Bars that do not cross zero indicate statistical significance at the 5 percent level (or higher).

Implications.

- Consistent with other research[17], we found that most of the K-3 literacy test-score convergence in our full sample appears to have occurred during the kindergarten year.
- Our findings, combined with those on prekindergarten programs in other contexts, suggest that the kindergarten teaching and learning context may be particularly important for sustaining the prekindergarten boost.

Study #4. If You Offer it, Will They Come? Patterns of Application Behavior in a Universal Prekindergarten Context

In localities with universal prekindergarten programs, not all eligible families apply to attend public prekindergarten for reasons that are not well understood. We used data from two cohorts of kindergarten students in the Boston Public Schools in 2008-2009 and 2009-2010 to answer our research questions[20]: How do kindergarteners who did and did not apply to BPS prekindergarten differ on observable demographic characteristics; on neighborhood characteristics and distribution across the city; and on the characteristics of the schools and the surrounding neighborhoods they attend in elementary school?

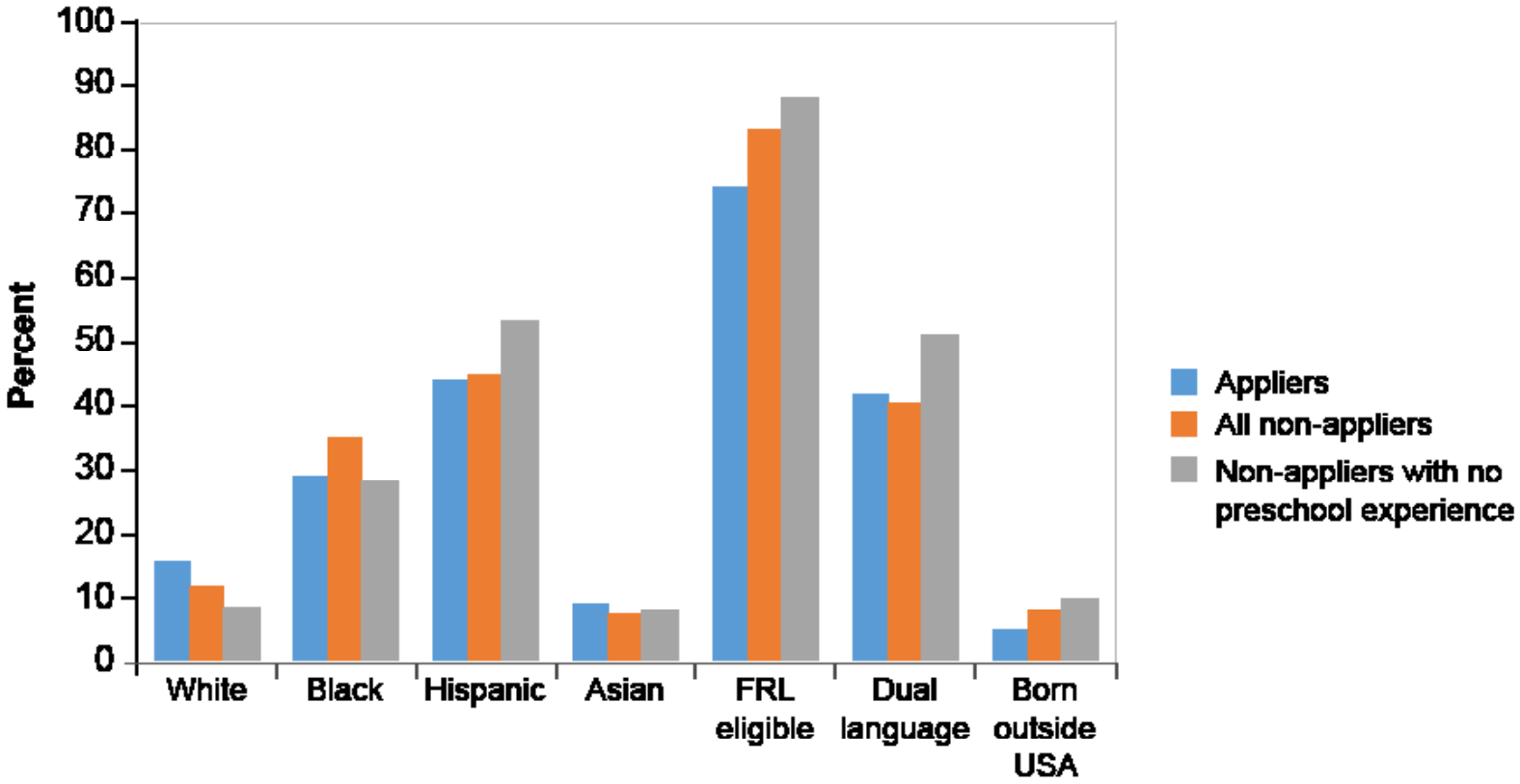
Study Design.

We focused on BPS kindergarten enrollees because their kindergarten attendance decision indicated that they were from families interested in attending the public schools. Our total sample was 8,391 children, 4,220 of whom applied to Boston prekindergarten in the year before kindergarten and 4,171 who had not. We compared the individual demographic characteristics and school-level K-3 school characteristics of kindergarteners who did and did not apply to the BPS prekindergarten program. We also examined the non-BPS care settings of non-appliers in the year before kindergarten. Finally, we used geographic information systems (GIS) software to link individual students to their home address in their kindergarten year. This allowed us to compare neighborhood-level characteristics of appliers and non-appliers. Using GIS, we also explored application patterns across the city that may inform future targeted recruitment efforts.

Key Findings.

- As shown in Figure 4, prekindergarten non-appliers were more likely to be non-white (particularly Latinx/Hispanic) and low-income than were prekindergarten appliers. Prekindergarten non-appliers with no preschool experience were more likely than appliers and all non-appliers to be dual language and Latinx/Hispanic. At third grade, appliers scored substantially higher than non-appliers on both math and reading state standardized tests (see Figure 5), were more likely to be placed in special education services, and less likely to be retained in grade.
- Neighborhoods and schools with more non-white, low-income, and dual language residents had higher concentrations of non-appliers.
- 71% percent of non-appliers attended a non-BPS prekindergarten program, with 32% of non-appliers enrolled in private programs and 36% in Head Start. Students who attended no form of prekindergarten were the most disadvantaged group of BPS kindergarten students, whereas students who attended private prekindergarten were the most advantaged.

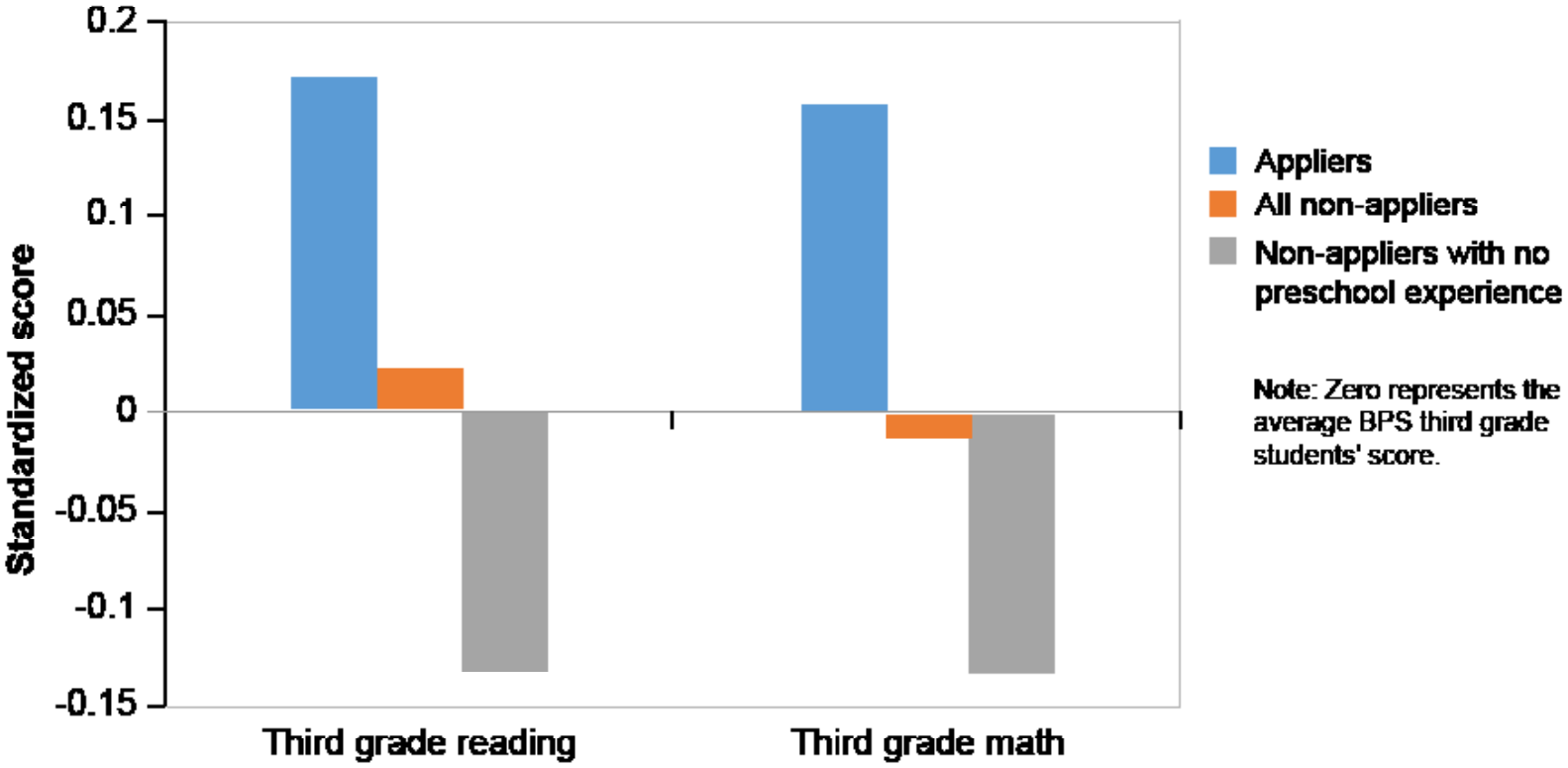
Figure 4: Demographic characteristics of Boston prekindergarten appliers, non-appliers, and non-appliers with no preschool experience



Implications.

- Less advantaged students are less likely to apply to Boston prekindergarten than their more advantaged peers. Non-appliers who do not attend an alternate preschool option are particularly disadvantaged.
- Families in neighborhoods with more non-white, low-income, and dual language residents are less likely to apply to prekindergarten, signaling an opportunity for more targeted program recruitment.
- As more localities implement universal prekindergarten, developing recruitment strategies that target those least likely to apply might aid localities in recruiting the students who could benefit most.

Figure 5: Third grade test scores for Boston prekindergarten appliers, non-appliers, and non-appliers with no preschool experience



End Notes

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20. We used data from two of the four cohorts of interest in Studies #1 and #2 because these two cohorts had more complete data on children's non-BPS care settings in the year before kindergarten.

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EPI Mission Statement

The central mission of the initiative is to engage in applied education policy research. The Education Policy Initiative is a program within the Ford School that brings together nationally-recognized education policy scholars focused on the generation and dissemination of policy-relevant education research. The primary goals of the initiative are to:

- Conduct rigorous research to inform education policy debates in Michigan and nationwide
- Disseminate best practices in education reform to local, state, and national policymakers, as well as to educational practitioners, parents, and students
- Train graduate students and others to conduct cutting-edge research in education
- Facilitate interactions between students and faculty from different schools and/or departments who share an interest in education reform.