

Policy Brief

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The Effects of Oklahoma's Pre-Kindergarten Program on 3rd Grade Test Scores

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We assess the effects of Oklahoma's universally
available pre-K program on 3rd grade test scores.

State-funded preschool programs have grown dramatically in recent years, with enrollment nearly doubling from 2002 to 2010. A total of 40 states are now serving almost 1.3 million children. Approximately 27 percent of all 4-year-olds are enrolled in state-funded pre-K programs, and an additional 11 percent are enrolled in Head Start. There is growing interest in whether preschool programs are effective, in both the short and longer terms.

Early childhood education has received strong support from advocates, public officials, and some scholars. But doubts about its long-term effectiveness persist. Though many previous studies have found strong preschool programs to have impressive long-term effects, others have found little evidence of persistent positive effects. Short-term effects of early childhood programs may fade out, so that they are barely measurable by the middle elementary years.

Our analysis uses data from Tulsa, Oklahoma, to examine the effects of pre-K participation on 3rd grade test scores. Previous studies using these data found significant positive effects on kindergarten test scores across subject areas. Our current analysis seeks to answer the question: do the short-term effects of a state-funded preschool program persist over time? Specifically, are differences in test scores between the children who participated in pre-K and a comparable group of children who did not still evident by the end of 3rd grade?

There are several reasons to expect persistence. First, brain research confirms that the early wiring of the brain is of critical importance to the brain's later development. Second, school districts throughout the U.S. are much more sensitive to testing and test results than they were a decade or two ago. Third, as preschool

enrollments have grown and as more children arrive at school ready to learn, K-3 teachers are better situated to ratchet up the level of instruction because a critical mass of students now has good basic skills.

On the other hand, there are reasons to expect fade-out. First, home factors continue to exert a strong negative pull on disadvantaged children. Second, the expansion of supportive services in the public schools may boost the achievement of under-performing children who did not attend preschool, making differences between preschool attendees and non-attendees less noticeable over time. Third, teachers in early elementary grades may not have adapted their teaching to reflect the growing presence of students who have benefited from preschool.

OKLAHOMA PRE-K PROGRAM AND DATA

We use data on test scores, as well as child and family
characteristics, from two cohorts of children in Tulsa.

Since 1998 Oklahoma has offered high-quality pre-K education, on a voluntary basis, to all four-year-old children. The state requires that no more than 20 children are in a class, and that child-to-staff ratios are no higher than 10 to 1. Lead teachers are required to have a B.A. and to be certified in early childhood education; they are paid according to the same salary and benefits schedule as other public school teachers.

We analyze the longer-term effects of Oklahoma's universal pre-K program for students in a particular district using three sources of data: administrative data from the Tulsa Public Schools (TPS), administrative data from the Oklahoma Department of Education, and parent survey data. Administrative records from TPS provided information on each student's pre-K program participation, date of birth, race/ethnicity, gender, and school lunch status (free, reduced-price, or full-price lunch). A survey on child and family characteristics was distributed in English and Spanish to parents. Third grade test scores were provided by the Oklahoma Department of Education. These test scores are based on the Oklahoma Core Curriculum Test (OCCT). Students were tested in both math and reading, and tested students received an overall performance score for each subject, the Oklahoma Performance Index (OPI). Our analysis does not include results from alternative tests that were administered for special needs students.

Data were collected for two cohorts of children. One cohort was enrolled in TPS kindergarten during the 2001-2002 school year (the “early cohort”), and another cohort was enrolled in TPS kindergarten during the 2006-2007 school year (the “late cohort”). We compare children who attended TPS pre-K with those who attended neither TPS pre-K nor Head Start. Comparison group children may have experienced other child care or preschool arrangements not measured in our data. In 3rd grade, the early cohort analysis sample includes a total of 1,999 children (1,038 treatment and 961 comparison), while the late cohort analysis sample includes 2,024 children (1,087 treatment and 937 comparison).

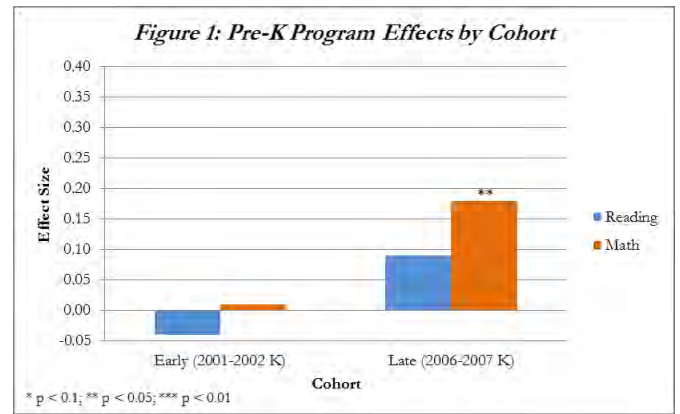
METHODS

To estimate the effects of TPS pre-K attendance on 3rd grade test score outcomes, we use propensity score matching (PSM) to compare outcomes of pre-K participants (the “treatment group”) to those of children who did not participate in TPS pre-K (the “comparison group”). Through propensity score matching, we construct a comparison group that resembles the treatment group as closely as possible on characteristics we can observe, such as race/ethnicity, gender, age, free-lunch eligibility, and selected family characteristics. We match each treatment group member with a comparison group member who is most similar in terms of these characteristics, and conduct diagnostic tests to assess comparability between the matched groups. In addition to matching, we use statistical controls for observable characteristics in a regression model that estimates the effect of TPS pre-K. The combination of these methods enhances our confidence that we have isolated the effects of pre-K enrollment and that our findings are not the result of underlying differences between the treatment and comparison groups on observable characteristics.

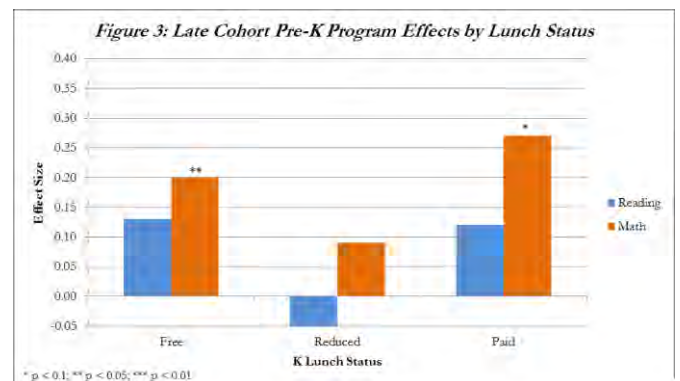
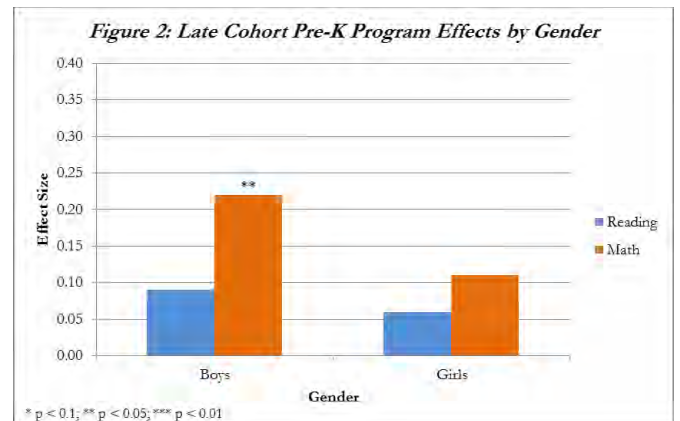
KEY FINDINGS

For the late cohort, we find statistically significant positive effects for math, for boys, and for free lunch-eligible students.

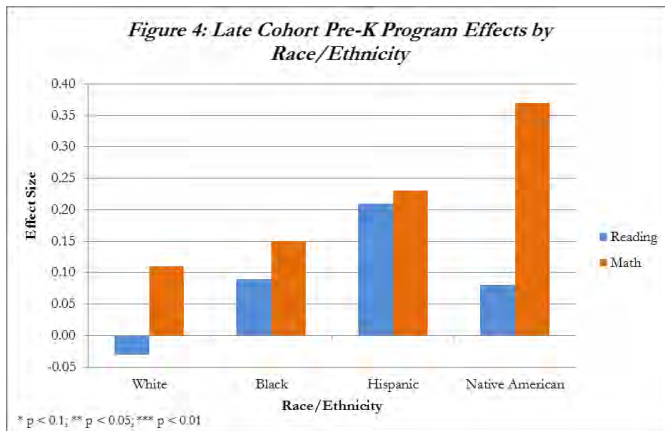
Figure 1 shows the estimated effects of TPS pre-K for the full sample. The results are expressed in effect sizes, that is, the difference in test scores for the treatment and comparison groups, expressed in terms of standard deviation units. For the early cohort we find no statistically significant effects on 3rd grade test scores of participating in the TPS pre-K program, for either reading or math. These results are consistent with the middle-elementary fade-out seen in some earlier studies. In contrast, for the late cohort, we do find statistically significant positive effects for 3rd grade math.



Although the pre-K program effects on 3rd grade math test scores for the late cohort are modest, they are larger for certain subgroups. In Figures 2-4, we show findings by gender, free-lunch eligibility, and race/ethnicity. We find that math gains are persisting for boys but not girls (Figure 2). We also find persistent math gains for free lunch-eligible students and a marginally significant positive relationship for math for full-price lunch (or middle-class) students (Figure 3). We find no statistically significant gains for particular racial/ethnic groups (Figure 4).¹



¹ We do find a marginally significant positive effect for pre-K participation on 3rd grade math scores for black males (Effect Size=0.31, p=0.105).



DISCUSSION

Our findings for the early cohort are consistent with the fade-out hypothesis, but our findings for the late cohort are not. The results present several puzzles. Why are the effects statistically significant for the second cohort but not the first? Why are effects statistically significant for math but not for reading? Why are effects statistically significant for boys but not girls? We offer several tentative explanations below.

Differences by Cohort

Pre-K program maturation and changes in K-3 instruction may explain the differences in program effectiveness by cohort.

A relatively simple factor – program maturation – is one possible explanation for differences across cohorts. For the early cohort, Oklahoma’s universal pre-K program was only in its third full year of operation. In the early years of implementation, TPS and other school systems made many choices (hiring, curriculum, professional development, etc.) quickly. Even if TPS hired good teachers and chose good curricula for the pre-K classroom, a policy shift of this magnitude takes time to implement effectively. Thus, one difference between the two cohorts may be that the pre-K program was running more smoothly in 2005-06 than it was in 2000-01.

Another possible explanation is parallel program adjustment. For short-term learning gains to be sustained, changes are almost certainly needed in K-3 instruction, including what is taught, when it is taught, and how it is taught. We have no systematic evidence on changes in K-3 teaching strategies in Tulsa over time; but reports from the field suggest growing awareness of school readiness improvements, which were well-publicized in Tulsa and which many teachers reported noticing themselves.

Differences by Subject

Persistent gains in math, but not reading, may occur because math learning tends to be more self-contained and confined to the classroom.

Differences in the persistence of learning gains between subjects (reading v. math) are somewhat unexpected. Initial learning gains for the late cohort, at the time of kindergarten entry, were substantially greater for pre-reading and pre-writing skills than for pre-math skills. Given these differences, one might expect the literacy effects to be more enduring through 3rd grade than the math effects. Yet that is not the case.

Perhaps the most convincing explanation for the persistence of early math gains, as opposed to early reading gains, is that math learning is more self-contained, more confined to the classroom, and less subject to either improvement or deterioration outside the classroom. Children’s verbal skills depend a great deal on their parents, their peers, and their neighbors, who can either enhance or damage those skills. In contrast, children’s math skills depend much more on what goes on inside the classroom. Whereas many parents read to their children, encourage reading, arrange play dates with other children who have above average verbal skills, and generally promote reading skills, few parents devote the same amount of energy to math skills. Thus, if pre-K math instruction creates an advantage for pre-K participants that non-participants do not have, that advantage is less likely to be eroded by family and neighborhood influences than the greater initial advantage in reading skills that pre-K participants experience.

Differences by Gender

Our positive findings on persistent cognitive effects for the late cohort are driven primarily by boys. The medium-term effects of the TPS pre-K program for boys are statistically significant for math and nearly significant for reading. Effect sizes for boys are twice as high as effect sizes for girls, for both math and reading. These results are somewhat surprising because, in the short run, effects of the TPS pre-K program on kindergarten math test scores were somewhat higher for girls than for boys. Yet, by 3rd grade, the boys who participated in TPS pre-K are doing better than other boys, while the girls who participated in TPS pre-K are roughly comparable to other girls.

Persistent gains for boys, but not girls, may be explained by differences in social-emotional maturity, cultural gender stereotypes, or Tulsa's specific math curriculum.

One possible explanation for gender differences in Tulsa could be differences in social-emotional maturity. From an early age, boys are less focused and more easily distracted than girls. A strong pre-K program, like Tulsa's, may keep boys on track and give them an edge as they move through the early elementary grades.

Another possibility is that girls are influenced by cultural gender stereotypes about math, making it more difficult for them to sustain early learning gains in this area. Math and science continue to be widely stereotyped as masculine domains. If cultural stereotypes about girls' competence and interest in math, however transmitted, lead girls to be less interested or engaged in math learning, then girls' early learning gains may be more difficult to sustain.

A final possibility is that the specific math intervention selected by TPS in 2003 helped boys preserve the gains they experienced in pre-K. That intervention, which featured the use of manipulatives (physical objects to be used for basic math exercises), may have been especially appealing to boys, whose brains are more geared for "spatial mechanical" functioning. Although comparison group boys also were exposed to manipulatives in grades K-3, the introduction of this technique at age 4 may have helped to make math more enjoyable and more accessible to treatment group boys during a receptive period of child development.

POLICY IMPLICATIONS

Pre-K program effects can improve over time as schools adapt their K-3 teaching practices. Public officials who launch new early childhood education programs may encounter disappointing medium-term results at first. It may take time for pre-K programs to mature and, more importantly, for elementary school personnel to make pedagogical adjustments that build on the new-found strengths of entering students. Such adjustments are critical if early learning gains are to be sustained.

Boys can remain engaged in learning if they get a strong start from a strong pre-K program. In recent years, a gender gap in school achievement has emerged, with boys having lower test scores, high school graduation rates, and college enrollment rates. The Tulsa results suggest that a strong pre-K program may help to equip boys to succeed in school later on.

Schools can sustain math gains through good curricular choices, but additional strategies are needed for reading. Schools have greater influence over students' mathematics skills than their reading skills, because math is more self-contained, less subject to home and neighborhood effects. Schools should carefully investigate which mathematics curricula are most likely to yield both short-term and long-term gains. For reading, they should seek to engage parents, whose active intervention may help to sustain short-term reading gains.

To place our findings in perspective, it should be noted that preschool program effects on school achievement almost always diminish over time, sometimes disappearing altogether by grade 3 or sooner. Yet some of these same studies have shown subsequent positive effects on high school completion, college attendance, and a wide variety of social outcomes for teenagers and adults. Whether this turns out to be true of the Tulsa pre-K program remains to be seen. However, it is clear that the Tulsa pre-K program, after maturing and becoming embedded in the elementary school's culture for a few years, has short-term effects on student achievement that remain discernible through at least grade 3.

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