The Effects of the New Mexico PreK Initiative on Young Children's School Readiness

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Executive Summary

This report estimates the effects of the New Mexico PreK initiative on entering kindergartners' academic skills using a rigorous research design. Receptive vocabulary, early literacy and early math skills were assessed in a sample of 886 children from across New Mexico. We found that the New Mexico PreK initiative has statistically significant and meaningful impacts on children's early language, literacy and mathematical development.

Specifically:

1. The New Mexico PreK initiative produces an increase in children's vocabulary scores of nearly 8 raw score points, 54 percent more growth over the year due to the program. This outcome is particularly important because the measure is strongly predictive of general cognitive abilities and later reading success.

2. Children who attended the New Mexico PreK initiative scored higher on a test of early math skills. The New Mexico PreK initiative increased children's math scores by about 2 raw score points, 40 percent more growth over the year due to the program. Skills tested include basic number concepts, simple addition and subtraction, telling time and counting money.

3. The New Mexico PreK initiative had large effects on children's understanding of print concepts. The program increased children's print awareness by nearly 26 percentage points, more than doubling growth over the year due to the program. Children who attended the New Mexico PreK initiative before entering kindergarten know more letters, more letter-sound associations and are more familiar with words and book concepts.

Using a sophisticated research design (the regression-discontinuity approach) we estimated the gains from one year of state-funded prekindergarten at age 4 compared to the preschool education experiences children would have had otherwise. This report is the first in a series of reports that will document the effects of the New Mexico PreK initiative over time.

Introduction

State-funded preschool initiatives have become increasingly common across the U.S., having been established to some extent in up to 38 states. While the services that these programs provide to families are influenced by complex parental needs, which may include longer hours, transportation, health services and the like, a main goal of all state-funded preschool programs is the preparation of young children for kindergarten. Effective preschool programs lay a foundation for children's subsequent school success by imparting the varied knowledge, abilities and dispositions children need to succeed in school such as rich vocabulary and complex sentence structure, an understanding of story structure, self-regulation, cooperative play and abstract thinking. This constellation of abilities provides children with the real confidence that success creates.

Previous research has established that high-quality and well-funded preschool programs make valuable contributions to improving children's learning and development (Barnett, 2002). Studies of model prekindergarten initiatives including the Abecedarian Early Childhood Intervention program, the High/Scope Perry Preschool program, and the Chicago Child-Parent Centers have shown that these types of programs produce economic benefits that are much greater than their costs (Barnett, 1996; Masse & Barnett, 2002; Reynolds, Temple, Robertson, & Mann, 2002). The benefits of preschool education include higher scores on achievement tests and lower rates of special education placements and grade repetition, as well as longer-term effects such as improved high school graduation rates and reduced levels of crime and delinquency.

Although state-financed preschool programs are not as well funded as many of the model programs that have been intensively studied, the state programs are larger and serve more diverse populations. As the number of state-funded preschool programs grows and more children participate, it is increasingly important to determine how effective these programs are in improving children's potential for school success.

The New Mexico PreK Initiative Context

The state-funded New Mexico PreK initiative was established in 2005 to provide center-based early education services to 4-year-olds across the state. New Mexico PreK sites must submit proposals for competitive funding, and the state's Pre-Kindergarten Act, NMSA 1978 § 32A-23-6 (2005) calls for these proposals to be "...evaluated on the percentage and number of public elementary schools in the community that are not meeting the proficiency component required for calculating adequate yearly progress and that are serving children, at least sixty-six percent of whom live within the attendance zone of a Title 1 elementary school." In prioritizing sites for funding, additional criteria specified in statute include such factors as the adequacy of prekindergarten sites that currently exist in a community, and the number of 4-year-olds in that community to be served by a proposed New Mexico PreK site, among other factors. The state appropriated $4.95 million to the New Mexico PreK initiative during the 2005-2006 school year, its first year of state funding.

To provide additional context for the findings of this study, we describe some characteristics of the New Mexico PreK initiative as listed in NIEER's *The State of Preschool 2006: State Preschool Yearbook* (Barnett, Hustedt, Hawkinson, & Robin, 2006). During the 2005-2006 school year, New Mexico PreK served 1,538 4-year-olds. Funds for the initiative were distributed nearly equally among the Public Education Department and the Children, Youth and Families Department. As a result, participating providers include public schools as well as private centers such as Head Start, child care facilities, faith-based centers, and tribal programs. Expansion of New Mexico PreK has been a priority, and enrollment increased to approximately 2,200 children in the 2006-2007 school year.

Methods

The Research Model

Our evaluation of the New Mexico PreK initiative employed a regression-discontinuity design (RDD), a statistical model with several strengths. This design addresses a vexing problem in educational research—selection bias. In state prekindergarten evaluations, program effects are typically estimated by comparing test scores of children who attended a program with the scores of similar children who did not. However, as programs move toward universal availability, finding a comparable group of children who did not attend is difficult. Even where programs target only some children (such as children from low-income families), a problem remains: those who attend preschool are not the same those who do not. Preschool programs that target specific groups of children create these differences, but differences also come about because some parents choose to enroll their children and others do not. In sum, children who attend state prekindergarten programs differ from those who do not because programs select children and families select programs.

The RDD solution is to compare two groups of children who enrolled in the New Mexico PreK initiative. These comparisons use the stringent age cutoff for enrollment eligibility (August 31) to define groups. This concept is easier to understand when taking the extreme case: consider two children who differ only in that one was born the day before the age cutoff and the other the day after. When both are about to turn 5 years old the slightly younger child will enter the preschool program and the slightly older child will enter kindergarten having completed the preschool program. If both are tested at that time, the difference in their scores provides an unbiased estimate of the state preschool program's effect. If only children with birthdays one day on either side of the age cutoff were included in a study, the sample size would be unreasonably small. However, the approach can be applied to wider age ranges around the cutoff. In fact, all children entering kindergarten having completed the New Mexico PreK initiative, and all children beginning New Mexico PreK in the same year, can be included in analyses using the RDD. The RDD approach has already been used to examine the effects of Oklahoma's universal prekindergarten program (Gormley, Gayer, Phillips, & Dawson, 2005) and in

several other states by NIEER (Barnett, Lamy, & Jung, 2005; Hustedt, Barnett, Jung, & Thomas, 2007).

Since our method of data analysis relies on conducting Fall assessments of children who have already completed state-funded preschool, it was not possible to employ the RDD approach during the initial year (2005-2006) of the New Mexico PreK initiative. In Fall 2006, we implemented the RDD approach in New Mexico for the first time, addressing the research question of whether participating in the New Mexico PreK initiative at age 4 has an impact on children's academic skills at kindergarten entry. We will conduct additional studies employing the RDD methodology in Fall 2007 and Fall 2008. Thus, the current report, focusing on Fall 2006 data, is the first report in a series. This series of reports will detail the estimated effects of the New Mexico PreK initiative as it matures.

Sampling Strategy

To begin the sample-selection process, we first identified all New Mexico PreK sites that started operating at the beginning of the 2005-2006 school year and continued operating during the 2006-2007 school year. Since the New Mexico PreK initiative enrolled children for the first time in 2005-2006, the communities where these sites were located were the only places we could expect to locate sufficient numbers of kindergartners who had already completed the initiative. At each identified PreK site we randomly chose a pre-specified number of children to be assessed, based on the proportion of New Mexico PreK enrollees statewide enrolled at that particular site. PreK children were then selected from class enrollment lists, using a procedure to ensure randomness, until we had conducted the designated number of assessments.

A corresponding number of kindergartners was chosen for each prekindergarten site. We identified kindergartners who had participated in the New Mexico PreK initiative during the previous year from the state's 2005-2006 enrollment list, and randomly selected children from that list. In Fall 2006, we tracked the selected children to their kindergarten classrooms using class rosters, and assessed them at their current elementary schools.

New Mexico-based research staff—trained by NIEER and working under the supervision of an Albuquerque-based coordinator and Utah State University—visited each sampled program site as well as the identified kindergarten sites in the same communities. Research staff conducted child assessments as early as possible in the school year.

The Sample

As mentioned above, our RDD methodology requires two groups of children. The group of kindergartners who attended the New Mexico PreK initiative the previous year is called the *Preschool* group, or the experimental group. Children who received some form of early care other than the New Mexico PreK initiative at age 4 were not included

in this group. The second group of children currently attending the New Mexico PreK initiative is called the *No Preschool* group, or the control group. This group is called the No Preschool group despite the fact that they are currently enrolled in the state-funded preschool program, because they are at the very beginning of their preschool year and have not had the preschool "treatment" yet.

In New Mexico, the No Preschool sample included 504 children enrolled in 86 New Mexico PreK classrooms across the state. The Preschool sample included 382 children enrolled in 179 kindergarten classrooms across the state. The total New Mexico sample size for Fall 2006 was 886 children.

Our primary analyses were "sharp" regression-discontinuity models that included a total 858 children in our sample, dropping 28 children (3.3% of the total) whose birth-date information appears to be inconsistent with the birth-date cut-off requirement for their programs. When less than 5% of the sample is dropped in this way, exclusion of such cases is thought to have little effect on the result (Judd & Kenny, 1981; Shadish, Cook, & Campbell, 2002; Trochim, 1984).

An average of 3.35 children were sampled per class. The sample is 51% male. Children's home languages are: English, 80.4%; Spanish, 14.1%; both English and Spanish, 3.5%; and Other, 1.3%. The percentage in each ethnic category is as follows: Latino, 56.2%; Native American, 27.6%; White, 10.4%; African American, 1.4%; Asian, 0.7%; and Other, 1.9%.

Ethnicities of participants in our study generally reflect those of the population of children participating in the New Mexico PreK program. For the 2006-2007 school year, the percentage of New Mexico PreK children in each ethnic category is as follows: Hispanic, 59.0%; American Indian and Alaska Native, 22.4%; Caucasian, 15.3%; Asian, 1.3%; and Black, 1.2%.

For purposes of comparison, New Mexico-specific estimates from the U.S. Census (Bureau of Business and Economic Research, n.d.) show that the percentage of New Mexico children ages birth to 5 in each ethnic category is as follows for 2005: Hispanic, all races, 52.2%; White, 30.4%; American Indian and Alaska Native, 13.2%; Two or more races, Non-Hispanic, 1.6%; Black, 1.5%; and Asian, 1.0%.

Instrumentation

Receptive Vocabulary. Children's receptive vocabulary was measured using the Peabody Picture Vocabulary Test, 3rd Edition (PPVT-III; Dunn & Dunn, 1997) and for Spanish-speakers, the *Test de Vocabulario en Imagenes Peabody* (TVIP; Dunn, Padilla, Lugo & Dunn, 1986). The PPVT is commonly used as quick test of IQ and can be used as a rough assessment of general cognitive abilities. The PPVT is a direct measure of vocabulary size, and the rank order of item difficulties is highly correlated with the frequency with which words are used in spoken and written language. The test is adaptive (to avoid floor and ceiling problems), establishing a floor below which the child

is assumed to know all the answers and a ceiling above which the child is assumed to know none of the answers. Reliability is good as judged by either split-half or test-retest reliabilities. The TVIP is appropriate for measuring growth in Spanish vocabulary for bilingual students and for monolingual Spanish speakers. Raw scores are reported.

All children in our sample were administered the PPVT, regardless of home language, to get some sense of their receptive vocabulary ability in English. All children who spoke some Spanish were also subsequently administered the TVIP. The testing session was then continued, with the additional measures administered in either English or Spanish, depending upon what the child's teacher designated as his or her best testing language.

Mathematical Skills. Children's early mathematical skills were measured with the Woodcock-Johnson Tests of Achievement, 3rd Edition (Woodcock, McGrew & Mather, 2001) Subtest 10 Applied Problems. For Spanish-speakers the *Bateria Woodcock-Munoz Pruebas de Aprovechamiento – Revisado* (Woodcock & Munoz, 1990) *Prueba 25 Problemas Aplicados* was used. Subtests of the Woodcock-Johnson are reported to have good reliability. Raw scores are reported here.

Print Awareness. Print awareness was measured using the Print Awareness subtest of the Preschool Comprehensive Test of Phonological and Print Processing (Pre-CTOPPP; Lonigan, Wagner, Torgeson & Rashotte, 2002; Pre-CTOPPP website, 2002) The Pre-CTOPPP was designed as a downward extension of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgeson & Rashotte, 1999), which measures phonological sensitivity in elementary school-aged children. Although not yet published, the Pre-CTOPPP has been used with middle-class and low-income samples and includes a Spanish version. As the Pre-CTOPPP was developed recently, relatively little technical information is available about its performance and psychometric properties.

Print Awareness items measure whether children recognize individual letters and letter-sound correspondences, and whether they differentiate words in print from pictures and other symbols. The percentage of items answered correctly out of the 36 total subtest items is reported.

Analyses

Our RDD analyses were conducted in STATA (StataCorp, 2005) using raw scores, and all standard errors were clustered by classroom. The primary analyses in the remainder of this report include children with birthdays up to 12 months before and 12 months after the kindergarten cut-off date. We prefer to emphasize the results using one year as the margin around the kindergarten cut-off date, because this provides the biggest sample size. However, we also conducted analyses restricting the sample to children born within 3- and 6-month spans before and after the cut-off date. Restricting the sample to those observations that are closer to the cut-point should reduce any potential bias, though the smaller samples do increase the standard errors. As shown in Table 1,

the results of the analyses using 3-, 6-, and 12-month margins are very similar. If anything, the 12-month estimates tend to be conservative.

Table 1. Estimated Effects Based on Margin Around Kindergarten Cut-Off Date

	3 months	6 months	12 months
Receptive vocabulary	13.12	8.37*	7.89*
Math Skills	1.62	1.91*	1.69*
Print Awareness	27.59*	26.10*	25.84*

* Significant at $p < .05$.

Also, in our analyses, there is no *a priori* expectation that the estimated relationship should be linear. Therefore, it is important to estimate higher order polynomial forms of the regression equation, as an additional check against mis-specifying the functional form of the regression line. We conducted squared and cubic transformations of the selection variable (the difference between birth date and cut-off date) and its interaction with the cut-off variable. Interactions were used to include higher order terms. In an analysis of third-order (cubic) polynomial regression models we found that the coefficients for the cubic term and its interaction with the cut-off dummy variable were not statistically significant. We then dropped these terms and estimated the second order model. In that analysis, the coefficients for the quadratic terms and quadratic interaction terms were not significant, except the quadratic term for the PPVT-III using a 3-month margin. We therefore report the results of the linear models.

All analyses were statistically controlled for the time of assessment, since assessments of children in the No Preschool group were completed closer to the beginning of the school year than those of children in the Preschool group. Additional covariates were used in our statistical models to control for child ethnicity, gender, and whether the assessment instruments were administered in English or Spanish.

Results

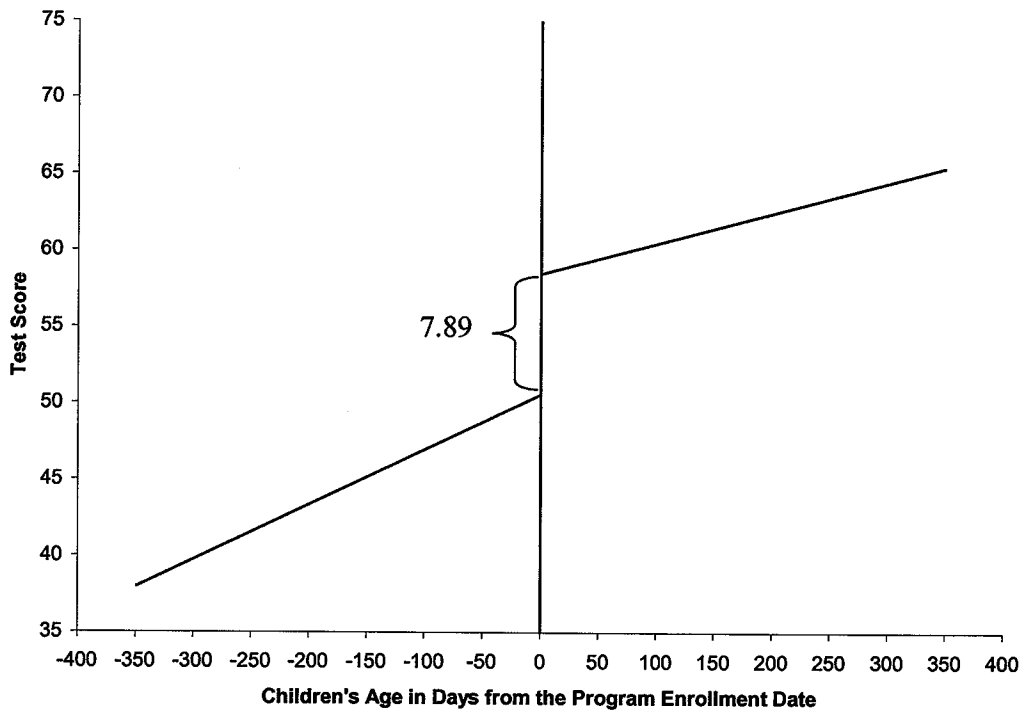
In the sections that follow, the estimated effects of the New Mexico PreK initiative are displayed in individual figures for the outcome measures of receptive vocabulary, mathematics, and print awareness. Each figure displays a regression line of the children's predicted test scores by age, measured by the number of days their birth date is from the program enrollment cut-off date. The discontinuity (gap or jump) in the regression line at the cut-off date is the estimated effect of the New Mexico PreK initiative.

Receptive Vocabulary

The estimated effect of state-funded preschool on children's receptive vocabulary as measured by the PPVT is statistically significant ($p < .01$). Attending the New Mexico PreK initiative at age 4 is estimated to increase PPVT scores by about 7.89 raw score points. This represents an improvement of about 36% of the standard deviation for the control (No Preschool) group. The effect of the program can also be understood as 54% more growth over the year in children's average vocabulary scores.

Figure 1 below portrays a regression line of the children's predicted PPVT scores by the distance in days their birth date is from the program enrollment cut-off date. The section of the line to the left of the program enrollment date represents receptive vocabulary scores of children beginning the state pre-K program, while the section of line to the right of the enrollment date represents scores for children entering kindergarten. The discontinuity in the regression line at the cut-off date represents the estimated effect of the preschool program, or 7.89 raw score points.

Figure 1. The Effect of the New Mexico PreK Initiative on Children's Receptive Vocabulary Scores

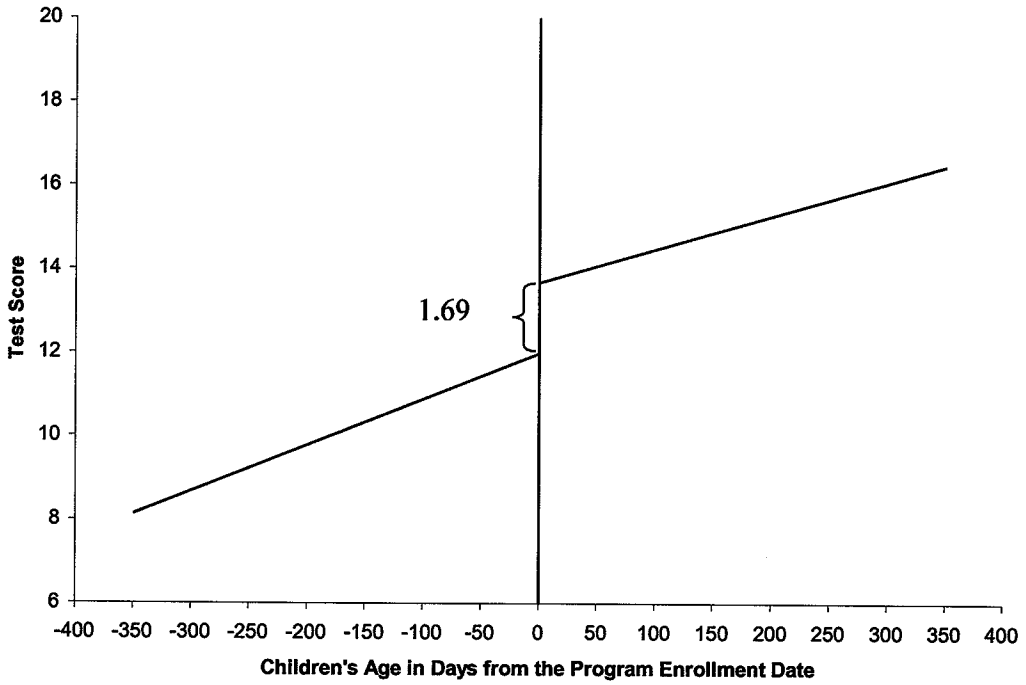


Math Skills

The estimated effect of state-funded preschool on children's early math skills as measured by the Woodcock-Johnson-III Applied Problems subtest scores is statistically significant for the New Mexico PreK initiative ($p < .05$). The increase in scores for New Mexico PreK children due to the program is about 1.69 raw score points. This represents an improvement of about 39% of the standard deviation for the control (No Preschool) group. The effect of the program can also be understood as 40% more growth over the year in children's average math scores.

Figure 2 below portrays a regression line of the children's predicted Applied Problems scores by the distance in days their birth date is from the program enrollment cut-off date. The section of line to the left of the program enrollment date represents math scores of children beginning the state pre-K program, while the section of line to the right of the enrollment date represents scores for children entering kindergarten. The discontinuity in the regression line at the cut-off date represents the estimated effect of the preschool program, or 1.69 raw score points.

Figure 2. The Effect of the New Mexico PreK Initiative on Children's Early Math Scores

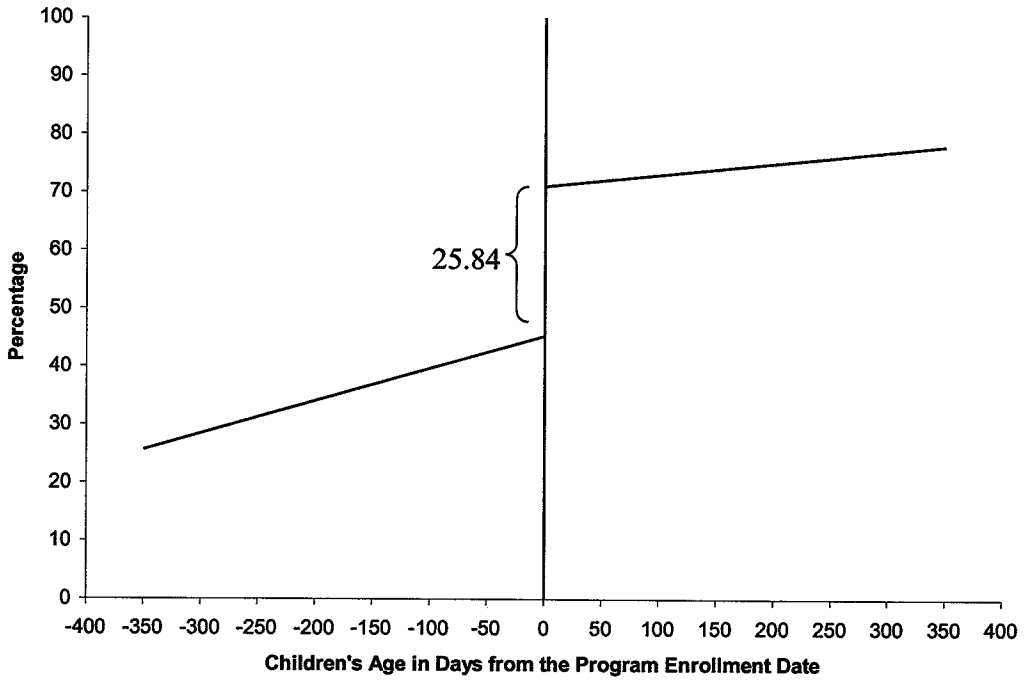


Print Awareness

The effect of state-funded preschool on children's Print Awareness scores is statistically significant for the New Mexico PreK initiative (p <.001). The effect of the New Mexico PreK initiative on children's gains in Print Awareness scores is 26% more items answered correctly. This increase represents approximately 116% of the control (No Preschool) group standard deviation on the Print Awareness subtest. The effect of the program can also be understood as more than doubling (118% more) growth over the year in children's average print awareness scores.

Figure 3 below portrays a regression line of the children's predicted Print Awareness scores by the distance in days their birth date is from the program enrollment cut-off date. The section of line to the left of the program enrollment date represents print awareness scores of children beginning the state pre-K program, while the section of line to the right of the enrollment date represents scores for children entering kindergarten. The discontinuity in the regression line at the cut-off date represents the estimated effect of the preschool program, or 25.84% more items answered correctly.

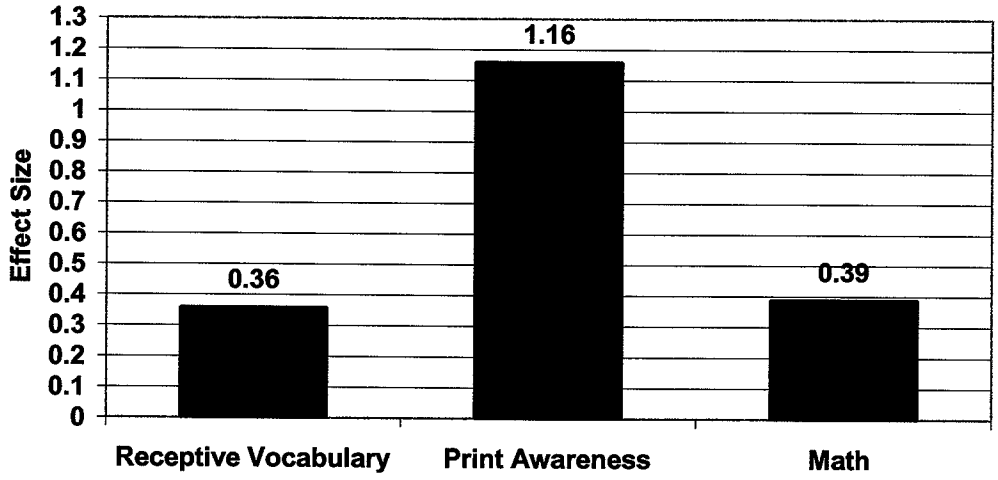
Figure 3. The Effect of the New Mexico PreK Initiative on Children's Print Awareness Scores



Summary and Discussion

In Figure 4 below we summarize our results in the form of estimated effect sizes for the impact of New Mexico PreK on children's receptive vocabulary, print awareness, and math scores. Effect sizes were calculated using the regression coefficient divided by the standard deviation of the comparison group, which is analogous to Glass's delta. These effect sizes are a common way of standardizing the estimated effects of the program for comparison across studies. The estimated effect sizes for New Mexico PreK are substantive and represent meaningful increases in early learning.

Figure 4. The Effect of the New Mexico PreK Initiative on Children's Scores across Measures



These results provide strong evidence that, during its first year of operations, the New Mexico PreK initiative had positive effects on children's learning in the areas of language, literacy and math skills. Our findings are promising, and indicate that New Mexico's state-funded prekindergarten initiative is producing the kinds of initial effects likely to lead to increased school success and continued advantages in reading and math skills. Meaningful effects were found on children's receptive vocabulary, math, and print awareness skills, with the largest effects apparent on children's early print awareness skills. Children's early print awareness and receptive vocabulary skills have been found to predict later reading abilities in the early elementary grades (Snow, Burns, & Griffin, 1998).

The estimated effects in New Mexico are comparable in size to those of other well-regarded state preschool initiatives, such as the one in Oklahoma (Gormley et al., 2005). In interpreting effect sizes, though, there are notable contextual differences with other states' prekindergarten initiatives. For example, in the previous evaluations of state prekindergarten initiatives reported by NIEER (see Barnett et al., 2005; Hustedt et al., 2007), the initiatives had been established for a longer period of time and placed a strong

emphasis on hiring lead teachers with a 4-year college degree. These issues are examined in greater depth, below, for the state of New Mexico. Also, New Mexico differs demographically from other states that have been studied using the RDD.

The effects found in this study are the first link in a chain that can produce the long-term school success and economic benefits found in other preschool education studies that have followed children into adulthood (Schweinhart, Montie, Ziang, Barnett, Belfield, & Nores, 2005; Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; Reynolds et al., 2002). However, in interpreting the findings, it is critical to emphasize that the Preschool group in this study experienced the New Mexico PreK initiative during the 2005-2006 school year. That was the initiative's first year of operations, and while data gathered during the early stages of a state prekindergarten initiative can be informative, they must also be regarded as preliminary. The context of state-financed prekindergarten may change as New Mexico's initiative expands and matures over time. As the program goes to scale, children's experiences may begin to differ from the findings reported here, and these findings may no longer be representative.

One factor that may have influenced the results is that the initiative was available on a fairly limited basis during 2005-2006, in terms of the number of sites and the number of children enrolled. It may be the case that providers selected to receive New Mexico PreK funding during 2005-2006 were those that already had a relatively sophisticated infrastructure to help support the new PreK initiative. In future years, as more slots are made available for children, the state of New Mexico may be faced with additional challenges in establishing new program sites.

It is also important to note that the teacher degree requirements in place during the 2005-2006 school year are anticipated to change in the future. Pre-service training by teachers is an important component of quality in prekindergarten programs (Barnett et al., 2006). Although lead teachers in PED PreK settings are currently required to have a minimum of a BA and hold a valid New Mexico Elementary Teaching License (K-8), they are strongly encouraged to acquire a New Mexico Early Childhood License and/or pursue coursework in early childhood education. Lead teachers in CYFD PreK settings, while not currently required to have a BA and early childhood licensure are expected to have both within the first 5 years of operation. Likewise, educational assistants are expected to have an AA in early childhood education within 5 years. Of the 70 lead teachers who provided their education level in a Spring 2006 NIEER teacher survey, 71.4% reported having at least a bachelor's degree. The percentage of teachers with a BA is likely to increase as more teachers move toward the state's 5-year milestone.

Finally, the Fall 2006 data collection period was prolonged due to difficulties in locating kindergartners who had completed the New Mexico PreK initiative. Although NIEER had access to a PreK participation list for the 2005-2006 school year, in many cases limited information was available about individual children's ultimate kindergarten destination. Due to the extra time spent tracking and locating these students, assessments of current New Mexico PreK children were finished earlier in the school year than assessments of the previous New Mexico PreK children. This necessitated an additional

level of statistical control for time of assessment that would not be required in the presence of more detailed tracking information.

This is the first in a series of reports on the effects of the New Mexico PreK initiative, focusing on child data collected in Fall 2006. The data presented here show that participation in the New Mexico PreK initiative has statistically significant effects on children's learning that are evident when they begin kindergarten. These findings are consistent with our findings from studies of other states' prekindergarten initiatives (Barnett et al., 2005; Hustedt et al., 2007). However, by repeating the RDD over two additional school years, we will gain further insight into changes in the impacts of the state-funded prekindergarten initiative as it expands to serve more children during the 2007-2008 and 2008-2009 school years. As a result, future reports will document progress by the New Mexico PreK initiative as it matures.

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