Effects of Participation in the North Carolina Pre-Kindergarten Program at the End of Kindergarten

2015-2016 Statewide Evaluation

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Purpose of the NC Pre-Kindergarten Evaluation Study

The primary purpose of the 2015-2016 NC Pre-Kindergarten (NC Pre-K) Evaluation study was to examine the long-term effects of participation in NC Pre-K at the end of kindergarten. Two groups of children were compared – those who attended NC Pre-K (treatment) and those who had not attended NC Pre-K (comparison). Propensity score matching (PSM) was used to select a matched sample of children with similar characteristics across the two groups.

The study included a total sample of 512 children (NC Pre-K=255, non NC Pre-K=257) who attended 135 kindergarten classrooms during the 2015-2016 academic year, including a subsample of 119 children (NC Pre-K=58, non-NC Pre-K=61) who were Spanish-speaking dual language learners (DLLs). Information was gathered from multiple sources, including individual assessments of children's outcomes and parent and teacher surveys. Assessment data were gathered in the late spring of kindergarten to examine the effects of participation in NC Pre-K on children's language, literacy, math, executive function, and behavior skills at the end of kindergarten. For the DLL subsample, skills were measured in both English and Spanish using parallel measures. Parent surveys provided demographic information about the children and families, and teacher surveys provided information about demographic characteristics and classroom characteristics.

In addition, key characteristics of the NC Pre-K Program during the 2015-2016 year, along with trends over time (2003-2004 to 2015-2016), were examined based on statewide administrative data (NC Pre-K Kids and NC Pre-K Plan). Information examined included characteristics of the local NC Pre-K settings, the children served, the qualifications of teachers, and the distributions and counts of program participants and service providers.

Since the inception of the statewide pre-k program in North Carolina in 2001–2002, the evaluation has been conducted by the FPG Child Development Institute at the University of North Carolina-Chapel Hill. See the Appendix for a list of previous reports for further information about prior years.

Overview of the NC Pre-Kindergarten Program

NC Pre-K is a state-funded educational program for eligible 4-year-olds, designed to enhance their school readiness skills. Initiated in 2001–2002, the program became statewide by 2003–2004.[a] Since its inception, the statewide pre-k program has served approximately 350,000 children. According to program guidelines,[i] children are eligible for NC Pre-K primarily based on age and family income. Children must be four years old by August 31 of the program year, with a gross family income at or below 75% of state median income. Within a local program, up to 20% of age-eligible children with higher family incomes may be enrolled if the child has at least one of the following additional factors: limited English proficiency, identified disability, chronic health condition, or educational need as indicated by results from developmental screening. In addition, children with a parent serving in the military are eligible regardless of family income or other eligibility factors.[b] NC Pre-K provides funding for serving eligible children in classroom-based educational programs in a variety of setting types, including public schools, Head Start, and private child care centers (both for-profit and nonprofit).

The requirements for NC Pre-K are designed to provide a high-quality, classroom-based educational experience for children, and to ensure uniformity in the program across the state, to the extent possible. The NC Pre-K Program operates on a school day and school calendar basis for 6-1/2 hours/day and 180 days/year. Local sites are expected to meet a variety of program standards around curriculum, screening and assessment, training and education levels for teachers and administrators, class size, adult:child ratios, North Carolina child care licensing levels, and provision of other program services.[i] Class sizes are restricted to 18 children with a lead and assistant teacher, with adult:child ratios of 1:9. Lead teachers are required to hold or be working toward a NC Birth through Kindergarten (B-K) license or the equivalent and assistant teachers are required to hold or be working toward an Associate Degree in early childhood education or child development (ECE/CD) or a Child Development Associate (CDA) credential. Classroom activities and instruction are based on the state early learning standards[ii] and an approved curriculum; classroom staff are expected to conduct developmental screenings and ongoing assessments to gather information on individual children's growth and skill development as well as to inform instruction. Monthly reimbursement rates by the NC Pre-K Program vary by the type of classroom and teacher qualifications, ranging from up to $400 per child (in Head Start sites) to a maximum of $650 (private sites with a B-K-licensed lead teacher), with an approximate average annual cost per child of $5,000.[iii]

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[a] In 2011, the North Carolina General Assembly transferred the existing state pre-k program from the Department of Public Instruction (DPI) to the Division of Child Development and Early Education (DCDEE) in the North Carolina Department of Health and Human Services (DHHS) and renamed it from the More at Four Pre-Kindergarten Program to the North Carolina Pre-Kindergarten Program.
[b] This eligibility factor was added to the program guidelines in 2007–2008.

Method

Sample Selection and Propensity Score Matching (PSM)

A propensity score matching (PSM) approach was used to select a matched sample of children who had attended NC Pre-K (treatment) and children who had not attended NC Pre-K (comparison) from kindergarten classrooms across the state. PSM is a quasi-experimental method that is designed to replicate a randomized controlled trial (RCT) in cases when a randomized experiment is not an option. PSM approximates an RCT in two important ways. First, it identifies treatment and comparison groups that are very similar to each other on a host of observed variables. This method is designed to balance treatment and comparison groups along all observed variables that are included in the modeling process. Therefore, insofar as the important characteristics of both groups are included (i.e., characteristics that are potential sources of bias) and a good balance is achieved between groups, the PSM removes selection bias. Second, in studies using PSM, outcome data are collected *after* the treatment and comparison groups are identified; thus self-selection bias into treatment conditions can be ruled out. In addition, the PSM method takes into account the associations between child/family characteristics and children's outcomes that may be in place between the beginning of participation in treatment and the time of data collection, thus providing a strong assurance that the effects of the treatment condition on the outcomes approximate causal effects.

A total of 24 counties in NC were identified as study sites in order to represent regions of the state (North, South, East, West), proportion of children in the NC Pre-K program (low, medium, high by terciles), and total number of children enrolled in NC Pre-K. A stratified random sample of 24 counties was selected from the 100 counties in NC based on region and proportion, weighted by the number enrolled. Two counties were randomly selected within each of the 12 region by proportion cells. A selected county was replaced with the next county on the randomly-generated list within a given cell in any cases where the school district(s) declined to participate.

A total of 33 school districts within 31 counties were initially contacted for participation in the study, with a final sample of 24 districts in 24 counties (77%). Within those 24 districts, we contacted the principals of 44 schools about the study, and 35 agreed for their schools to participate (80%). All 174 kindergarten teachers within these schools were contacted, and 153 agreed to participate in the study (88%). Information describing the study, parent permission forms, and the parent survey forms were sent home to all 2,843 parents within these classrooms; 1,524 gave permission for their children to participate in the study (54%).

Once individuals who did not return survey information or those who returned forms after the deadline were excluded, an initial pool of 1,355 kindergarten children was established for the study from these 24 school districts. Children then were excluded from this initial pool who did not meet any of the following eligibility criteria for the study: had been retained in grade; had a birthdate outside the treatment window (before 9/1/09 or after 8/31/10); did not meet NC Pre-K income-eligibility criteria; had an IEP; attended an NC Pre-K site but were not funded through

NC Pre-K (to avoid confounds between the treatment and comparison groups); and had incomplete data used for matching.

This procedure resulted in an input sample of 823 cases. Each child in the input sample was identified as either a treatment (attended NC Pre-K; n=432) or comparison (did not attend NC Pre-K; n=391) case based on a series of questions about Pre-K attendance from parent survey information and validated against the NC Pre-K state administrative data which includes information on individual children. Propensity-score matching (PSM) was then used to select a matched sample of children across the treatment and comparison groups. Logistic regression was used to apply the propensity score model to predict likelihood of treatment as a function of the following child and family characteristics: gender, Hispanic/Latino ethnicity, race (Black/African-American, Native American, Asian, with White as a reference cell), chronic health condition, child speaks English at home, English is child's first language, frequency primary caregiver speaks English at home, parent in the military, primary caregiver education, family size, number of adults in the home, number of children in the home, family income, and whether the parent survey was completed in English. This procedure resulted in a matched sample of 532 children (n=266 treatment and n=266 comparison), and a DLL subsample of 122 children (n=59 treatment and n=63 comparison). (See Analysis Approach for further details.) The matched sample was well balanced on all child and family characteristics included in the matching process, as indicated by the standardized mean differences before and after matching (see Table 1). Moreover, the matched sample had an equal number of treatment and comparison participants, and it was large enough to have the statistical power to detect small effects.

Participants

Teachers/Classrooms

The final study sample included 135 teachers in kindergarten classrooms located within 34 schools in 24 districts (counties) across NC. As seen in Table 2, the vast majority of teachers were female and White. About two-thirds (66%) of the teachers held a Bachelor's degree and the remaining one-third (34%) held a Master's degree. The majority (80%) had an Elementary Education license, with most of the remainder (19%) having a B-K license; 16% had national board certification. Teachers reported an average of about 2 years teaching kindergarten, but an average of about 12 years of total teaching experience. The average class size was approximately 20 children (about half boys and half girls), and about 80% of the children had English as a primary language, about 13% Spanish, and about 6% both English and Spanish.

Analyses were conducted to compare the treatment (NC Pre-K) and comparison (non-NC Pre-K) groups on the various teacher and classroom characteristics. There were no significant differences between the two groups on any of the teacher or classroom characteristics. (See Analysis Approach for further details.)

Children

The final study sample consisted of 512 children (n=255 treatment, n=257 comparison), with a DLL subsample of 119 children (n=58 treatment, n=61 comparison). Following the selection of the matched sample of 532 children, outcome data were not gathered for 20 children, resulting in an attrition rate of 3.7% (3 in the DLL subsample, 2.5%), which is considered negligible in educational research. Reasons for attrition included child moved to another school district not in the study sample (n=9), moved out of state (n=6), moved to another school within the same district that declined to participate in study (n=4), and withdrew from school (n=1).

The characteristics of children in the NC Pre-K and non-NC Pre-K groups generally were similar, as seen in Table 3. Slightly over half (53%) were girls, about half (50%) were White and half (50%) were non-White, and just under one-third (29%) were of Hispanic/Latino ethnicity. Almost 13% of the children were reported to have a chronic health condition. Over 80% of the primary caregivers reported that they always or frequently speak English at home, with just under 20% using English never, rarely, or sometimes. The majority (63%) of families had incomes in a range below $26,070, with an average family size of about 4, and about 12% having a parent in the military. Over half (57%) of the primary caregivers had a High School Diploma, and slightly under one-quarter each (22%) had less than a high school education or a college degree or above.

There were some differences in the distributions of child and family characteristics for the DLL subsample compared to the full sample (see Table 4). About one-quarter (25%) of the children were White and about three-quarters were non-White (75%), and all (100%) were of Hispanic/Latino ethnicity. Primary caregivers reported frequently or always speaking English in the home less than one-third (29%) of the time, with 41% using English sometimes and 30% rarely or never. About 75% of families had incomes in a range below $26,070, with an average family size of about 5, and about 19% having a parent in the military. Over half (57%) of the primary caregivers had less than a high school education, just under 40% had a High School Diploma, and fewer than 5% had a college degree.

Analyses were conducted to compare the treatment (NC Pre-K) and comparison (non-NC Pre-K) groups on the various child characteristics within the full sample. The results revealed that there were no significant differences between the two groups on any of these characteristics. (See Analysis Approach for further details.)

Measures and Procedures

Child Assessments

Child outcomes data were gathered in the late spring (4/18/15–5/27/15) near the end of kindergarten for both the treatment and comparison groups. Individual child assessments were conducted on site at the schools by trained data collectors, and teachers were asked to complete behavior rating scales following each assessment. All children in the study sample were administered the child assessment measures in English. Parallel assessment procedures were

used with the DLL subsample, with a second administration of the same measures in Spanish by a bilingual data collector approximately 2 weeks later.

The child assessment battery consisted of measures appropriate for kindergartners across five primary areas—language, literacy, math, executive function, and behavior skills. See Table 5 for an overview of these measures, including key constructs and scoring. All of the child assessment measures were available in both English and Spanish versions. Most of the measures used in the study were norm-referenced, so that for most outcomes, standard scores could be used. These scores take into account children's age, so that the standardized mean score of 100 represents the expected performance for an average child at a given age.

Language and literacy skills were assessed with five subtests from the Woodcock-Johnson III Tests of Achievement (WJ III)[iv] in English and the Batería III Woodcock-Muñoz Pruebas de Aprovechamiento (Bat III)[v] in Spanish. Two measures of language skills were used. The Picture Vocabulary subtest measured vocabulary skills, including aspects of both receptive and expressive language. The Sound Awareness subtest measured phonological awareness skills, including rhyming and phonemic awareness. Five measures of literacy skills were used. The Letter-Word Identification subtest measured basic pre-reading and reading skills, including letter and word recognition and identification skills. The Passage Comprehension subtest measured symbolic learning and basic comprehension skills. The Word Attack subtest measured phonemic awareness skills, including knowledge of letter sounds and sound combinations. In addition, two composite measures were included based on combinations of specific subtests – Basic Reading Skills composite (Letter-Word Identification and Word Attack) and Brief Reading composite (Letter-Word Identification and Passage Comprehension).

Math skills were assessed with three measures from the WJ III/Bat III. The Applied Problems subtest measured math problem-solving skills including simple comparisons, counting, addition, and subtraction. The Calculation subtest measured basic mathematical computation skills. In addition, the Brief Math composite, a composite measure based on these two subtests was used.

Executive function was assessed using two measures, Forward Digit Span and Backward Digit Span.[vi] The Digit Span measures assess different components of children's working memory. Forward Digit Span tests the phonological loop component of working memory and Backward Digit Span tests the central executive function component of working memory.

Behavior skills were assessed with two subscales of the Social Skills Improvement System (SSiS)[vii] completed by teachers. The Social Skills subscale involved ratings of behaviors that promote positive interactions while discouraging negative interactions. The Problem Behaviors subscale involved ratings of negative behaviors, some commonly occurring and some less commonly, that interfere with social skills development.

Teacher Surveys

Kindergarten teachers in the study sample were asked to complete electronic surveys about demographic and classroom characteristics. Teacher surveys were completed by 100% of the 135 teachers in the kindergarten classrooms in the study. The surveys included items about teacher demographic characteristics (gender, race, ethnicity), teacher qualifications (education, licensure, board certification, teaching experience), and classroom characteristics (class size, proportion of boys/girls, and proportion of children with English/Spanish/both English and Spanish/Other home languages).

Parent Surveys

Demographic surveys were gathered from the initial pool of 1,355 children/families at the time of study recruitment. Children's primary caregivers were asked to complete information about child, family, and household characteristics that were used for study eligibility determination and assignment to treatment/comparison conditions. Survey information also was used for the PSM modeling to determine the matched treatment and comparison samples for the study. Survey items included children's demographic characteristics (birthdate, gender, race, ethnicity); NC Pre-K Program-related risk factors [IEP status, chronic health condition, first language and language spoken at home (English, Spanish, both English and Spanish, Other), parent in the military]; Pre-K experience (type of setting, hours in pre-k, name, location, and teacher); and family and household characteristics [frequency of English spoken at home by primary caregiver, household composition, primary caregivers' education, family income (categorical ranges)]. For the final study sample, the vast majority of survey respondents identified as the children's primary caregivers were mothers. Survey respondents included mothers (89%), fathers (6%), grandmothers (3%), and others (2%; stepmother, aunt, grandfather, legal guardian).

Analysis Approach

Propensity Score Matching (PSM)

Propensity-score matching (PSM) was used to select a matched sample of children across the treatment and comparison groups from the input sample. Propensity scores were generated using the Matchit function of R, based on 1:1 nearest neighbor matching with a strict caliper of 0.1 SD of the propensity score. Cases were randomly ordered within groups prior to matching, and cases that did not have good matches were discarded. The use of 1:1 matching allowed for equal sample sizes between the treatment and comparison groups. The use of the caliper required that the difference between matched treatment and comparison cases on the propensity scores be less than the specified value of 0.1 SD. It was used to improve the quality of the matches and balance across groups by pruning cases that do not have adequate matches, but also reduces sample size. However, this trade-off is encountered in random assignment and quasi-experimental designs in which the quality of the match between the treatment and comparison groups is the primary focus.

Next, the propensity score model was designed and applied to the input sample using logistic regression, where likelihood of treatment was modeled as a function of the following child and family characteristics (with county as a fixed effect): gender, Hispanic/Latino ethnicity, race (Black/African-American, Native American, Asian, with White as a reference cell), chronic health condition, child speaks English at home, English is child's first language, frequency of English spoken at home by primary caregiver, parent in the military, primary caregiver education, family size, number of adults in the home, number of children in the home, family income, and whether the parent survey was completed in English.

Sample Comparisons

Standardized mean differences were the main statistic used to assess the quality of the matching for the treatment and comparison groups after the PSM model was applied. The reduction of standardized mean difference along each variable in the PSM model before and after matching indicates how different the two groups (treatment and comparison) were before the matching and how similar they were after the matching took place. A stringent cutoff of SD$\leq$.10 was used in this study.

Analyses were conducted to compare the treatment and comparison groups to determine whether there were any differences in key variables. T-test comparisons were conducted for a variety of teacher and classroom characteristics gathered from teacher survey data, including teacher demographic characteristics (gender, race, ethnicity), teacher qualifications (education, licensure, national board certification, teaching experience), and classroom characteristics (class size, proportion of boys, and proportion of children with English/Spanish/both English and Spanish home languages). T-test comparisons also were conducted for a variety of child and family characteristics gathered from parent survey data, including children's demographic characteristics (gender, race, ethnicity); risk factors (IEP status, chronic health condition, military parent); and family and household characteristics (frequency of English spoken at home by primary caregiver, family size, primary caregivers' education, family income).

Child Outcomes Regression Analyses

Analyses using two-level regression models were conducted to test each of the outcomes as a function of treatment condition. With a few exceptions, the set of child and family characteristics that were included in the PSM logistic regression model were included in these analyses as "doubly robust" control variables to remove any remaining bias due to continuing associations between these variables and the outcomes from the beginning of treatment (i.e., beginning of the Pre-K year) until the time of assessment of outcomes (i.e., end of kindergarten year). Three modifications were made to the set of control variables that were included. Given the small n's for some of the racial categories, the separate variables were replaced with a White/non-White variable. Because of high inter-correlations and concerns about multicollinearity, three language variables were dropped (child speaks English at home, English is child's first language, and whether the survey was completed in English), as they were highly correlated with the frequency the primary caregiver speaks English at home (r=.84 and r=.85 respectively). Also, of the three variables that are related to household composition, we

retained family size, but excluded the number of adults and number of children as the family size variable is the sum of those two excluded variables.

Mixed models included nesting of children within schools; nesting within classrooms was not feasible, as several classrooms contained only one or two study children. The outcome variables were W scores for the WJ III / Bat III subtests and composites (in accord with current best practice), standard scores for both SSiS measures, and raw scores for both Digit Span measures. Effect sizes were calculated for significant and marginally significant treatment effects using Cohen's *d* (Mean difference/Pooled variance). Effect sizes around 0.20 are considered small, around 0.50 medium, around 0.80 large, and around 1.20 very large.[viii, ix]

Program Characteristics

Descriptive Analyses

Descriptive analyses were conducted to examine key characteristics for the NC Pre-K Program. Data from the statewide administrative databases (NC Pre-K Kids and NC Pre-K Plan) were examined for the current study year (2015-2016), including number of sites, classrooms, and children; class size and proportion of NC Pre-K children; days of attendance and operation; licensing ratings; curricula and assessments used; setting types; child characteristics; and teacher education and licensure/credentials.

Trends over Time

Trend analyses were conducted to examine whether there were changes in key program characteristics over time. Data were examined from the statewide administrative databases (NC Pre-K Kids and NC Pre-K Plan) for each program year from 2003–2004 (the first year the program was statewide) to 2015–2016 (the current year of the study). Data from each program year were considered to be independent. The characteristics examined included teacher qualifications (whether teachers had a bachelor's degree or above, whether teachers had a B-K license or the equivalent, whether teachers had no credential), classroom setting types (public schools, private settings, and Head Start), and children's prior placement (proportion never served, proportion not served at time of enrollment), with dichotomous variables created for each of the six teacher qualifications and setting type characteristics and continuous variables created for the two prior placement variables. Separate trend analyses were conducted for each of the eight key program characteristics, with R^2 (1 - SSresidual/SStotal) calculated to estimate the trend's goodness-to-fit to the data. For these analyses, R^2 can range from 0 to 1, where 1 indicates perfect fit and $R^2 > 0.7$ indicates an acceptable linear trend.

Results

Treatment Effects

Full Sample

The effects of participation in the NC Pre-K Program were examined by comparing results at the end of kindergarten for two groups of children - NC Pre-K (treatment) and non-NC Pre-K (comparison) – using PSM for assignment to groups. The mean scores on language, literacy, math, executive function, and behavior skills outcome measures by treatment group are shown in Table 6. Means for standard scores generally were in the average to slightly above average range for all of the language, literacy, math, and behavior skills norm-referenced measures for both groups, except for vocabulary (WJ III Picture Vocabulary), which was slightly below average. For the executive function measures, scores on Forward Digit Span were substantially higher with greater variability for both groups than scores on Backward Digit Span.

Regression analyses tested whether there were significant treatment effects at the end of kindergarten for participation in NC Pre-K, with results shown in Table 7 and Table 8. These analyses took into account key child and family characteristics that were used in the PSM for assignment to treatment/comparison groups and that may contribute to differences in children's outcomes at the end of kindergarten (see Analysis Approach for further details).

No significant effects were found for treatment on most of the language measures (WJ III Picture Vocabulary), literacy measures (WJ III Letter-Word Identification, WJ III Passage Comprehension, WJ III Word Attack, WJ III Basic Reading, WJ III Brief Reading), or teacher ratings of behavior skills (SSiS Social Skills, SSiS Problem Behaviors). There was a marginally significant result (p<.06) for the language measure of phonological awareness (WJ III Sound Awareness), in the direction of positive effects for the NC Pre-K group (see Figure 1). The effect size for this result was in the small range: WJ III Sound Awareness *d*=0.15.

In contrast, there were significant treatment effects in the area of math for most measures. Children in the NC Pre-K group scored higher than those in the non-NC Pre-K group on two of the three math measures (WJ III Calculation, WJ III Brief Math composite). The results on the third measure (WJ III Applied Problems) were marginally significant (p<.06) in the direction of positive effects for the NC Pre-K group. (See Figure 1.) Effect sizes for these results were in the small range: WJ III Calculation *d*=0.21, WJ III Brief Math *d*=0.22, and WJ III Applied Problems *d*=0.16.

There also were significant treatment effects for executive function on one of the two measures (Forward Digit Span), with significantly higher scores for children who attended NC Pre-K than those who did not. (See Figure 2.) The effect size for this result was in the small range: Forward Digit Span *d*=0.17.

It is worth noting that three of the covariates used for the PSM accounted for significant portions of the variance across most language, literacy, math, and behavior skills measures:

gender (positive associations for girls), primary caregiver education (positive associations for higher education), and family income (positive associations for higher income).

DLL Subsample

English Outcomes

Similar sets of analyses were conducted to examine results for the Spanish-speaking DLL subsample on measures administered in both English and Spanish. Mean scores for the DLL subsample by treatment group on language, literacy, math, and executive function measures in English, along with teacher ratings of behavior skills, are shown in Table 9. Similar to the full sample, standard scores for the DLL subsample generally were close to or slightly above the norm; the one exception was vocabulary (WJ III Picture Vocabulary) which evidenced mean scores more than one standard deviation below the norm for both groups of children. Also similar to the full sample, there were differences in the patterns of the two executive function measures, with higher scores and greater variability for both groups on Forward Digit Span than on Backward Digit Span.

Regression analyses tested whether there were significant treatment effects for the DLL subsample on English measures at the end of kindergarten (see Table 10 and Table 11). There were no significant treatment effects within the DLL subsample for most measures, including all of the language (WJ III Picture Vocabulary, WJ III Sound Awareness), literacy (WJ III Letter-Word Identification, WJ III Passage Comprehension, WJ III Word Attack, WJ III Basic Reading, WJ III Brief Reading), and math measures (WJ III Calculation, WJ III Applied Problems, WJ III Brief Math).

For executive function, there were significant treatment effects for Forward Digit Span, with higher scores for children in the NC Pre-K group; results were not significant for Backward Digit Span. (See Figure 2.) There also were significant treatment effects for teacher ratings of social skills, with higher ratings for NC Pre-K children. (See Figure 3.) The effect sizes for these results were in the medium range: Forward Digit Span d=0.39 and SSiS Social Skills d=0.41.

Two of the covariates used for the PSM, primary caregiver education and family income, accounted for significant portions of the variance across most literacy and math measures similar to the full sample. Higher scores were associated with higher levels of education and income for these outcomes.

Spanish Outcomes

Mean scores for language, literacy, math, and executive function measures in Spanish for the DLL subsample by treatment group are shown in Table 12. Across both groups, scores were generally lower in Spanish than in English. Scores were slightly below the norm for some literacy (Bat III Letter-Word Identification, Bat III Word Attack, Bat III Basic Reading) and math measures (Bat III Applied Problems). Scores on the executive function measures (Forward Digit Span, Backward Digit Span) were similar to or slightly lower than those in English. For most measures, however, scores were substantially lower, with means in the range of 1 SD below the

norm (Bat III Sound Awareness, Bat III Passage Comprehension, Bat III Calculation, Bat III Brief Math) to more than 2 SD below the norm (Bat III Picture Vocabulary, Bat III Brief Reading).

Regression analyses tested whether there were treatment effects for the DLL subsample on Spanish measures at the end of kindergarten (see Table 13 and Table 14). There were no significant treatment effects within the DLL subsample for any of the outcomes measured in Spanish: language (WJ III Picture Vocabulary, WJ III Sound Awareness), literacy (WJ III Letter-Word Identification, WJ III Passage Comprehension, WJ III Word Attack, WJ III Basic Reading, WJ III Brief Reading), math (WJ III Calculation, WJ III Applied Problems, WJ III Brief Math), and executive function (Forward Digit Span, Backward Digit Span).

There were some similarities and some differences in the pattern of significance for covariates compared to those found for the DLL subsample English measures and the full sample. In contrast to these other results, negative associations were found between the frequency of English spoken at home by the primary caregiver with scores on most language and literacy measures in Spanish (more English spoken at home was associated with lower scores in Spanish). Positive associations were found for family income with all language, literacy, and math measures in Spanish (higher scores were associated with higher family income), similar to the pattern found for DLL subsample English measures as well as for the full sample.

NC Pre-K Program Characteristics

Descriptive Results

Descriptive data were analyzed to provide information about the NC Pre-K Program for the 2015-2016 school year. In 2015–2016, the NC Pre-K Program served 28,757 children in 1,962 classrooms located in 1,157 sites. More than three-quarters (78%) of the programs were at the highest, five-star licensing level, with another 17% at the four-star level, and the remainder temporary or in process. The average total class size was 16 children, with 13 of those children (85%) funded by NC Pre-K. On average, children attended NC Pre-K for 140 days, which represents 81% of the 173 actual days of operation or 78% of the 180 planned instructional days offered by the program. (See Table 15.) Almost all classrooms reported using a primary curriculum, ongoing assessment tool, and developmental screening tool from the approved lists provided by the NC Pre-K Program Guidelines. The vast majority of classrooms reported using Creative Curriculum and its companion assessment (Teaching Strategies Gold); the most common screening tools were DIAL and Brigance (see Table 16). NC Pre-K classrooms were located in approximately half (52%) public school settings; about one-third (33%) private settings (25% for-profit and 8% non-profit child care centers); and 16% Head Start (5% administered by public schools and 11% not). (See Table 17.)

In 2015–2016, the program served children from a variety of racial and ethnic backgrounds, including over one-half children of diverse, non-White racial backgrounds and one-quarter children of Hispanic/Latino ethnicity (see Table 18). Children served by the NC Pre-K Program primarily came from low-income families, with 90% eligible for free or reduced-price lunch. Children also varied on other eligibility factors, ranging from 19-23% with limited English proficiency or a developmental/educational need to 5-6% with an identified disability, chronic

health condition, or military parent (see Table 19). Information on children's prior placement indicated that almost three-quarters had never previously been served in any preschool setting (59%) or were currently unserved (14%) at the time of enrollment (see Table 20).

One consistent change in the program has been the increases in teacher education and credentials over time. Almost all (over 99%) lead teachers in the NC Pre-K Program in 2015–2016 had at least a bachelor's degree in both public school and private settings. (See Table 21.) Nearly all teachers in public school settings (96%) and over three-quarters of the teachers in private settings (77%) had a Birth-Kindergarten (B-K) license (or the equivalent). Relatively few teachers in public school settings (1%) and in private settings (16%) were reported to have no credential (see Table 22).

Trend Analyses

Results from trend analyses examined whether there have been any long-term changes in key program characteristics since the NC Pre-K Program (formerly More at Four) became statewide (2003-2004) through the current year (2015-2016). Distributions are shown for program characteristics over time, including setting type (see Table 23), children's prior placement (see Table 24), teacher education (see Table 25), and teacher licensure/credentials (see Table 26). The results of the trend analyses for the distribution of classrooms by setting types (percentages of public preschool, private, and Head Start) indicated that there was little change over time, with no evidence of linear trends for any of these categories (as indicated by $R^2 < .70$). (See Figure 4.) The results for children's prior placement similarly showed fairly consistent patterns over time, with no evidence of linear trends for the proportion of children never served (never served) and the proportion not served at the time of enrollment (unserved). (See Figure 5.) In contrast, there were significant changes over time for all three aspects of teacher qualifications that were examined (see Figure 6). For teacher education (percentage with bachelor's degree or above), results indicate an increasing trend over time ($R^2 = 0.77$). It should be noted that teacher education has essentially reached the maximum level from cohorts 9-13, which decreases the goodness-of-fit statistic, although it is still within the acceptable range. For lead teacher licensure and credentials, the results indicate two parallel trends – an increasing trend in the percentage of those with a B-K license ($R^2 = 0.97$) and a decreasing trend in the percentage of those with no credential ($R^2 = 0.77$). It should be noted that the large decrease in those with no credential between the first and second cohorts explains the lower goodness-of-fit statistic, although it is still within the acceptable range.

Conclusions

A PSM design was used to compare language, literacy, math, executive function, and behavior skills outcomes at the end of kindergarten for children who attended NC Pre-K (treatment) to those who had not attended NC Pre-K (comparison). PSM is a quasi-experimental technique that approximates an RCT approach by creating matched treatment and comparison groups based on a range of variables prior to data collection. This study found significant treatment effects for participation in the NC Pre-K Program on children's outcomes at the end of

kindergarten in the areas of math skills and executive function. Although effect sizes were in the small range, there were effects across all aspects of math. There were significant differences for calculation skills and the math composite, and marginally significant differences for math problem-solving. In contrast, there were almost no effects found in the areas of language and literacy skills, with the exception of one marginally significant finding for phonological awareness skills.

This pattern of effects for early math and reading skills at the end of kindergarten is consistent with results from data showing that, compared to math, performance in reading tends to drop off in later grades for NC students relative to national samples. Recent results from the National Assessment of Educational Progress (NAEP) showed that NC students performed above the national average on both math and reading assessments in fourth grade; however, by eighth grade, scores for reading were below the national average while scores for math were consistent with the national average.[x, xi] Moreover, higher percentages of children reached proficiency on the math assessments than on the reading assessments.

For Spanish-speaking DLLs, treatment effects were found for social skills ratings by teachers and for the same measure of executive function as for the full sample, with effect sizes in the medium range. Taken together, the significant findings for these two measures suggests a pattern of positive effects for the NC Pre-K Program on different aspects of self-regulatory skills for DLLs. These results are consistent with other studies that have shown advantages for DLLs and children of immigrant parents in executive function and social and emotional skills before and at kindergarten entry. [xii, xiii, xiv, xv, xvi]

Significant differences were found across both the full sample and the DLL subsample on one of the two measures of executive function (Forward Digit Span), with effect sizes in the small to medium range. The other measure (Backward Digit Span) had much lower average scores and a narrower range, and therefore, may have demanded skills that were too difficult for children of this age from a relatively low-income, more at-risk sample (in accord with the target group for NC Pre-K and confirmed by the propensity score model). These findings on better outcomes for children who attended NC Pre-K are important, because a strong body of research for school-age children has shown that executive function is associated with academic achievement in language, literacy, and math.[xvii, xviii, xix, xx, xxi, xxii] Research with preschoolers has found that executive function predicts both concurrent and later academic skills as well as attention and self-regulation in the classroom.[xxiii, xxiv, xxv, xxvi, xxvii, xxviii, xxix]

In contrast, there were no treatment effects for any domains of learning for the DLL subsample when skills were measured in Spanish. Children's scores in Spanish were substantially lower than in English for most measures, and well below the norm for children their age in many cases. Given that instruction both in the pre-k program and in kindergarten was primarily in English, it is not surprising that children's scores for these types of language and academic skills would be relatively lower in Spanish than in English. However, it also is important to note that the scores on English measures also tended to be lower for children in the DLL subsample than in the full sample, with no treatment effects in the DLL subsample for language, literacy, or

math skills. Given these results, it may be important to examine the use of practices to support the learning needs of DLLs in the pre-k and kindergarten programs, including practices such as the use of home language or differentiated instructional approaches.

It is of interest that some of the family characteristics covariates had differential impacts for outcomes measured in English versus in Spanish for the DLL subsample. In all cases (outcomes for the full sample, outcomes in English and Spanish for the DLL subsample), family income accounted for significant portions of the variance on most outcomes. For outcomes measured in English, for both the full sample and the DLL subsample, primary caregiver education also was a significant contributor in most cases. For outcomes measured in Spanish, however, rather than primary caregiver education, the frequency of English spoken at home was associated (negatively) with most language and literacy outcomes in Spanish – a result that probably is not surprising, but worth noting.

The current results for the NC Pre-K Program are similar to other studies using PSM approaches to examine the impact of pre-k programs on children's school readiness and kindergarten skills. Positive effects of participation in pre-k programs were found for children's math skills at kindergarten entry, based on both national (ECLS-K) and state pre-k (Georgia's Pre-K) samples.[xxx, xxxi] These results mirror the consistent findings regarding treatment effects for NC Pre-K on children's math skills at the end of kindergarten. Positive results also were found for social-emotional skills in kindergarten for public pre-k participants (Tulsa Public Schools), with similar findings for the free-lunch eligible sample.[xxxii] The latter result is particularly relevant to the present results for self-regulatory skills (executive function and social skills), given the similarity to the population of NC Pre-K participants – about 75% of whom are eligible for free lunch, with another 15% eligible for reduced-price lunch. However, these other studies also found positive treatment effects for language and literacy skills (in addition to math skills) in kindergarten.[xxx, xxxi] These findings contrast with the relative lack of treatment effects in these domains for the NC Pre-K sample (one marginally significant result for phonological awareness). In part, this difference may be explained by differences in the samples – both of the other studies were based on universal pre-k programs serving an overall less disadvantaged population economically and educationally.

In sum, these results suggest that the NC Pre-K Program demonstrated consistent, positive effects on children's skills at the end of kindergarten in two key domains of learning – math skills and executive function. These results were based on comparison to a propensity score matched sample of children who did not attend NC Pre-K, thus using a quasi-experimental technique that approximates an RCT approach. However, these findings also suggest that it may be important to examine ways to further enhance children's learning in the areas of language and literacy. Although children generally were scoring in the expected ranges for their age in most skills areas, there were no differences between NC Pre-K and non-NC Pre-K children in language and literacy skills – a fundamental area for later school success. Further, the results were less robust for the DLL subsample, with findings only in the area of executive function skills in English and social skills. Given these results, it is important to examine the instructional practices in place within the pre-k program as well as the subsequent kindergarten

classrooms attended by NC Pre-K children to ensure that practices are in place to support the learning needs of all children.

Summary of Findings

Treatment Effects

Children who attended NC Pre-K performed significantly better on math skills at the end of kindergarten compared to a matched group of children who did not attend NC Pre-K. Children in the NC Pre-K group had higher scores on calculation skills and the math composite, and marginally higher scores on math problem-solving. These results were based on a propensity-score matched sample of over 500 NC Pre-K and non-NC Pre-K children, with effect sizes in the small range (. 16-.22).

There was little difference between a matched sample of NC Pre-K and non-NC Pre-K children on language and literacy skills at the end of kindergarten. In contrast to the findings for math skills, there were almost no differences in language and literacy skills, with the exception of one marginally significant finding for phonological awareness skills (effect size=.15). These results are consistent with data from national assessments such as NAEP showing relatively stronger performance in math than reading for NC students in later grades.

Participation in NC Pre-K had positive effects on children's executive function at the end of kindergarten for both the full sample and the DLL subsample. Children who attended NC Pre-K performed better on a measure of executive function related to working memory compared to their peers who did not attend NC Pre-K. The effect sizes for these results were in the small range (.17) for the full matched sample of over 500 children and in the medium range (.39) for the subsample of over 100 Spanish-speaking DLLs. These results are important, because executive function is predictive of children's later academic performance.

Program Characteristics

Many of the characteristics of the NC Pre-K Program were consistent with good quality standards, as well as with program guidelines. In 2015–2016, the average NC Pre-K class included a total of 16 children, with 13 (85%) funded by NC Pre-K. This number is actually below the program guidelines which specify a maximum class size of 18. The majority of the programs (78%) were at the highest, five-star licensing level, with another 17% at the four-star level. The average days of child attendance was 140 days (81% of the average days of operation).

In general, most program characteristics have been fairly stable over time. In 2015–2016, the NC Pre-K Program served nearly 29,000 children in over 1,900 classrooms located in more than 1,100 sites. The majority of children were from low-income families (90% qualified for free or reduced-price lunch). There were no changes over time in setting types, with about half in public schools, about one-third in private settings, and 16% in Head Start. Children's prior placement also has remained consistent over time; over 70% of the children had never been served or were currently unserved in a preschool setting.

One continuing trend in the NC Pre-K Program has been improvement in the levels of teacher education and credentials. There have been significant trends toward increasing teacher education and licensure levels, and a significant decreasing trend in those with no credential over the past 13 years, since NC Pre-K became a statewide program. In 2015–2016, almost all NC Pre-K lead teachers had at least a bachelor's degree in both public school and private settings (>99%). Nearly all lead teachers in public schools and over three-quarters in private settings had a B-K license, while relatively few teachers had no credential.

Table 1. Treatment and Comparison Group Means Before and After Propensity Score Matching

	Before Matching			After Matching		
	NC Pre-K Mean (n=432)	Non-NC Pre-K Mean (n=391)	Standard Mean Difference	NC Pre-K Mean (n=266)	Non-NC Pre-K Mean (n=266)	Standard Mean Difference
Child Characteristics						
Gender[a]	0.5141	0.4560	0.1160	0.4662	0.4774	-0.0225
Latino ethnicity[b]	0.3325	0.2917	0.0865	0.2669	0.3045	-0.0797
Race[c]						
Black	0.3223	0.2986	0.0505	0.3534	0.3195	0.0723
American Indian/Alaska Native	0.0512	0.0417	0.0430	0.0376	0.0489	-0.0511
Asian	0.0102	0.0231	-0.1282	0.0113	0.0150	-0.0373
Chronic health condition[d]	0.1100	0.1250	-0.0480	0.1316	0.1278	0.0120
Child's first language is English[e]	0.7008	0.7685	-0.1478	0.7782	0.7632	0.0328
Child speaks English at home[f]	0.6931	0.7454	-0.1132	0.7669	0.7481	0.0407
Family Characteristics						
English spoken at home[g]	3.3325	3.4560	-0.1090	3.5000	3.4699	0.0265
Parent in military[h]	0.1611	0.1134	0.1296	0.1128	0.1241	-0.0306
Primary caregiver education[i]	2.9616	2.9051	0.0546	2.9812	2.9850	-0.0036
Family size	4.4066	4.5023	-0.0716	4.3233	4.4549	-0.0985
Number of adults in the home	1.9412	1.9421	-0.0012	1.9173	1.9586	-0.0541
Number of children in the home	2.5320	2.6829	-0.1412	2.4925	2.6053	-0.1055
Family income[j]	1.6854	1.7106	-0.0240	1.6842	1.7180	-0.0321
Survey completed in English[k]	0.7877	0.8542	-0.1623	0.8647	0.8459	0.0459

[a] Female=0, Male=1

[b] Non-Latino=0, Latino=1

[c] Race reference cell=White

[d] No=0, Yes=1

[e] No=0, Yes=1

[f] No=0, Yes=1

[g] Never=0, Rarely=1, Sometimes=2, Frequently=3, Always=4

[h] No=0, Yes=1

[i] 8th grade or less=1, Some High School=2, High School Diploma/GED=3, AA/AS degree=4, BA/BS degree=5, MA/MS degree=6, Doctorate degree=7, N/A=8

[j] $26,069 or less=1, $26,070 - $34,090=2, $34,091 - $42,112=3, $42,113 - $50,113=4, $50,114 - $58,154=5, $58,155 - $66,176=6, $66,177 - $67,680=7, $67,681 - $69,184=8, $69,185 - $70,688=9, $70,689 - $72,192=10, $72,193 - $73,669=11, $73,670 - $75,200=12, $75,201 or more=13

[k] No=0, Yes=1

Table 2. Characteristics of Sample Teachers and Classrooms (2015–2016)

	n=135 %/Mean (SD)	n/Range
Teacher Characteristics		
Gender		
Male	1.5%	2
Female	98.5%	133
Race		
White/European-American	90.4%	122
Black/African-American	5.9%	8
Native American/Alaskan Native	0.7%	1
Asian	1.5%	2
Other	3.0%	4
Hispanic/Latino ethnicity	5.2%	7
Education		
BA/BS	65.9%	89
MA/MS or higher	34.1%	46
Licensure		
Birth to Kindergarten (B-K)[a]	19.3%	26
Elementary Education[a]	80.0%	108
Other[b]	1.5%	2
National Board Certification	16.3%	22
Teacher Experience		
Years of experience teaching kindergarten	2.1 (4.2)	0-23
Years of experience teaching any age group	12.3 (8.6)	0.5-43
Classroom Characteristics		
Class size	19.6 (2.6)	6-24
Number of boys	52.0%	
Proportion of children's home languages		
English[c]	80.0%	
Spanish[c]	13.0%	
Both Spanish and English	6.0.%	
Other[d]	1.0%	

[a] One teacher had both a B-K and Elementary Education license; one teacher had both a B-K and Special Education license

[b] Other licenses include: AG K-12 license, Educational Leadership

[c] Note: n=134

[d] Other languages spoken: Arabic, Bengali, Chinese, French, Hmong, Indian, Korean, Naples, Q'anjobal/Spanish, Quiché/Spanish, Vietnamese, Armehic, Congolese, Laos, Aguateco/Spanish, Marshallese, Tectiteco/Spanish

Table 3. Characteristics of Sample Children (2015–2016)

	All n=512		NC Pre-K n=255		Non-NC Pre-K n=257	
	%/mean (SD)	n	%/mean (SD)	n	%/mean (SD)	n
Child Characteristics						
Gender						
Male	47.1%	241	47.5%	121	46.7%	120
Female	52.9%	271	52.6%	134	53.3%	137
Ethnicity						
Non-Hispanic/Latino	71.3%	365	72.9%	186	69.7%	179
Hispanic/Latino	28.7%	147	27.1%	69	30.4%	78
Race						
White	50.4%	258	49.8%	127	49.4%	127
Non-white	49.6%	254	50.2%	128	50.6%	130
Chronic health condition	12.5%	64	12.6%	32	12.5%	32
Family Characteristics						
English spoken at home						
Never	2.3%	12	2.0%	5	2.7%	7
Rarely	5.1%	26	5.9%	15	4.3%	11
Sometimes	10.4%	53	10.2%	26	10.5%	27
Frequently	6.8%	35	5.5%	14	8.2%	21
Always	75.4%	386	76.5%	195	74.3%	191
Parent in military	11.7%	60	11.0%	28	12.5%	32
Primary caregiver education						
Less than High School	21.7%	111	23.5%	60	19.8%	51
High School	56.8%	291	54.1%	138	59.5%	153
AA/AS	15.6%	80	14.9%	38	16.3%	42
BA/BS	4.9%	25	6.7%	17	3.1%	8
MA/MS or above	1.0%	5	0.8%	2	1.2%	3
Family size	4.4 (1.4)	512	4.3 (1.3)	255	4.5 (1.4)	257
Family income						
$26,069 or less	62.7%	321	61.2%	156	64.2%	165
$26,070 - $34,090	18.2%	93	20.4%	52	16.0%	41
$34,091 - $42,112	9.8%	50	11.0%	28	8.6%	22
$42,113 - $50,113	5.5%	28	5.55	14	5.5%	14
$50,114 - $58,154	3.1%	16	1.2%	3	5.1%	13
$58,155 - $66,176	0.8%	4	0.8%	2	0.8%	2

Table 4. Characteristics of DLL Subsample (2015–2016)

	All n=119		NC Pre-K n=58		Non-NC Pre-K n=61	
	%/mean (SD)	n	%/mean (SD)	n	%/mean (SD)	n
Child Characteristics						
Gender						
Male	47.1%	56	50%	29	44.3%	27
Female	52.9%	63	50%	29	55.7%	34
Ethnicity						
Non-Hispanic/Latino	0.0%	0	0.0%	0	0.0%	0
Hispanic/Latino	100.0%	119	100.0%	58	100.0%	61
Race						
White	25.2%	30	34.5%	20	16.4%	10
Non-white	74.8%	89	65.5%	38	83.6%	51
Chronic health condition	7.6%	9	6.9%	4	8.2%	5
English spoken at home						
Never	9.2%	11	8.6%	5	9.8%	6
Rarely	21.0%	25	24.1%	14	18.0%	11
Sometimes	41.2%	49	39.7%	23	42.6%	26
Frequently	22.7%	27	20.7%	12	24.6%	15
Always	5.9%	7	6.9%	4	4.9%	3
Family Characteristics						
Parent in military	18.5%	22	12.1%	7	24.6%	15
Primary caregiver education						
Less than High School	57.1%	68	58.6%	34	55.7%	34
High School or less	38.7%	46	34.5%	20	42.6%	26
AA/AS	3.4%	4	5.2%	3	1.6%	1
BA/BS	0.8%	1	1.7%	1	0.0%	0
Family size	4.7 (1.4)	119	4.5 (1.2)	58	4.9 (1.5)	61
Family income						
$26,069 or less	74.8%	89	74.1%	43	75.4%	46
$26,070 - $34,090	16.0%	19	17.2%	10	14.8%	9
$34,091 - $42,112	5.9%	7	3.5%	2	8.2%	5
$42,113 - $50,113	3.4%	4	5.2%	3	1.6%	1

Table 5. Child Outcome Measures

Measure	Scoring
Language and Literacy Skills	
Letter-Word Identification	
Woodcock-Johnson III Tests of Achievement Letter-Word Identification (Subtest 1) / Batería III Woodcock Muñoz Pruebas de Aprovechamiento Identificación de Letras y Palabras (Prueba 1)	Standard score Mean=100, SD=15
Comprehension	
Woodcock-Johnson III Tests of Achievement Passage Comprehension (Subtest 9) / Batería III Woodcock Muñoz Pruebas de Aprovechamiento Comprension de textos (Prueba 9)	Standard score Mean=100, SD=15
Phonemic Awareness	
Woodcock-Johnson III Tests of Achievement Word Attack (Subtest 13) / Batería III Woodcock Muñoz Pruebas de Aprovechamiento Análisis de palabras (Prueba 13)	Standard score Mean=100, SD=15
Vocabulary	
Woodcock-Johnson III Tests of Achievement Picture Vocabulary (Subtest 14) / Batería III Woodcock Muñoz Pruebas de Aprovechamiento Vocabulario sobre dibujos (Prueba 14)	Standard score Mean=100, SD=15
Phonological Awareness	
Woodcock-Johnson III Tests of Achievement Sound Awareness (Subtest 21) / Batería III Woodcock Muñoz Pruebas de Aprovechamiento Discernimiento de Sonidos (Prueba 21)	Standard score Mean=100, SD=15
Math Skills	
Basic Calculations	
Woodcock-Johnson III Tests of Achievement Calculation (Subtest 5) / Batería III Woodcock Muñoz Pruebas de Aprovechamiento Cálculo (Prueba 5)	Standard score Mean=100, SD=15
Math Problem-Solving	
Woodcock-Johnson III Tests of Achievement Applied Problems (Subtest 10) / Batería III Woodcock Muñoz Pruebas de Aprovechamiento Problemas Aplicados (Prueba 10)	Standard score Mean=100, SD=15
Executive Function	
Working Memory	Raw Score
Forward Digit Span (English/Spanish)	Range=1-8
Backward Digit Span (English/Spanish)	Range=1-8
Behavior Skills	
Social Skills	
Social Skills Improvement System (SSiS) Social Skills subscale	Standard score Mean=100, SD=15
Problem Behaviors	
Social Skills Improvement System (SSiS) Problem Behaviors subscale	Standard score Mean=100, SD=15

Table 6. Kindergarten Outcome Scores for Full Sample

Measure	All			NC Pre-K			Non-NC Pre-K		
	n	Mean (SD) Range		n	Mean (SD) Range		n	Mean (SD) Range	
Language									
WJ III Picture Vocabulary[a]	512	93.8 (11.6) 35-122		255	94.3 (10.9) 50-122		257	93.4 (12.2) 35-118	
WJ III Sound Awareness[a]	512	105.9 (20.0) 41-161		255	107.2 (19.3) 41-146		257	104.6 (20.7) 49-161	
Literacy									
WJ III Letter-Word Identification[a]	512	111.4 (12.6) 70-169		255	111.1 (12.7) 79-152		257	111.8 (12.4) 70-169	
WJ III Word Attack[a]	512	110.7 (12.2) 68-144		255	110.6 (12.4) 68-144		257	110.9 (12.1) 70-143	
WJ III Passage Comprehension[a]	511	101.8 (13.4) 46-142		254	102.0 (13.5) 46-140		257	101.7 (13.3) 67-142	
WJ III Basic Reading Skills Composite[a]	512	111.5 (12.5) 68-159		255	111.3 (12.7) 77-152		257	111.8 (12.3) 68-159	
WJ III Brief Reading Composite[a]	511	107.4 (13.2) 68-159		254	107.4 (13.3) 68-151		257	107.5 (13.2) 71-159	
Math									
WJ III Calculation[a]	472	105.9 (16.6) 60-140		243	106.5 (16.4) 60-137		229	105.3 (16.7) 64-140	
WJ III Applied Problems[a]	511	102.3 (12.3) 4-135		254	102.8 (13.6) 4-131		257	101.7 (10.7) 69-135	
WJ III Brief Math Composite[a]	510	103.3 (16.0) 53-142		253	104.6 (16.2) 53-137		257	102.0 (15.7) 61-142	
Executive Function									
Forward Digit Span[b]	512	3.9 (0.9) 1-8		255	4.0 (0.8) 1-7		257	3.9 (0.9) 1-8	
Backward Digit Span[b]	512	1.9 (0.7) 1-4		255	1.9 (0.6) 1-4		257	1.8 (0.7) 1-4	
Behavior Skills									
SSiS Social Skills[a]	510	98.4 (15.4) 43-130		253	98.5 (15.5) 43-130		257	98.2 (15.4) 58-130	
SSiS Problem Behaviors[a]	512	100.2 (15.5) 83-160		255	100.7 (15.8) 83-160		257	99.7 (15.3) 83-160	

[a] Indicates standard scores on norm-referenced measure with mean=100, SD=15. WJ III scores reflect use of updated normative tables (2007).
[b] Possible range=1-8

Table 7. Full Sample Regression Results—Language and Literacy Measures

	Language				Literacy									
	WJ III Picture Vocabulary n=512		WJ III Sound Awareness n=512		WJ III Letter-Word Identification n=512		WJ III Word Attack n=512		WJ III Passage Comprehension n=511		WJ III Basic Reading Composite n=512		WJ III Brief Reading Composite n=511	
	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)
Intercept	453.05	(3.09)	455.56	(5.00)	409.20	(9.10)	447.44	(8.56)	429.45	(7.06)	428.19	(8.36)	418.69	(7.61)
Child Characteristics														
Gender[b]	0.02	(0.80)	-4.04**	(1.28)	-4.85*	(2.31)	-4.81*	(2.19)	-5.62**	(1.83)	-4.77*	(2.13)	-5.16**	(1.95)
Latino ethnicity[c]	-5.70***	(1.33)	-4.15+	(2.15)	-3.84	(3.90)	-0.33	(3.68)	-4.53	(3.05)	-2.04	(3.59)	-4.10	(3.27)
Race[d]	2.82**	(0.86)	2.62+	(1.40)	0.57	(2.56)	4.34+	(2.40)	-0.31	(1.97)	2.42	(2.35)	0.22	(2.13)
Chronic health condition[e]	0.82	(1.22)	-4.46*	(1.95)	-6.92+	(3.52)	-4.07	(3.34)	-4.89+	(2.79)	-5.39+	(3.24)	-6.04*	(2.97)
Family Characteristics														
English spoken at home[f]	4.13***	(0.61)	1.94*	(0.98)	-1.49	(1.78)	-0.85	(1.68)	-0.14	(1.40)	-1.15	(1.64)	-0.70	(1.50)
Parent in military[g]	-2.87*	(1.27)	-2.40	(2.04)	1.18	(3.70)	1.09	(3.50)	-1.94	(2.90)	1.20	(3.41)	-0.30	(3.11)
Primary caregiver education[h]	0.91+	(0.49)	2.67***	(0.78)	6.00***	(1.42)	4.07**	(1.34)	3.08**	(1.11)	5.04***	(1.31)	4.49***	(1.19)
Family size	-0.39	(0.30)	-0.62	(0.49)	-2.73**	(0.88)	-2.53**	(0.83)	-1.76*	(0.70)	-2.61**	(0.81)	-2.15**	(0.74)
Family income[i]	1.06**	(0.39)	1.71**	(0.64)	4.19***	(1.16)	4.31***	(1.09)	3.66***	(0.90)	4.26***	(1.06)	3.89***	(0.97)
Treatment[j]	**1.04**	**(0.79)**	**2.44+**	**(1.26)**	**0.72**	**(2.27)**	**1.46**	**(2.16)**	**2.28**	**(1.81)**	**0.98**	**(2.10)**	**1.58**	**(1.92)**

[a] Significance levels are ***p< .001, **p< .01, *p< .05, +p<.10

[b] Female=0, Male=1

[c] Non-Latino=0, Latino=1

[d] Non-White=0, White = 1

[e] No=0, Yes=1

[f] Never=0, Rarely=1, Sometimes=2, Frequently=3, Always=4

[g] No=0, Yes=1

[h] 8th grade or less=1, Some High School=2, High School Diploma/GED=3, AA/AS degree=4, BA/BS degree=5, MA/MS degree=6, Doctorate degree=7, N/A=8

[i] $26,069 or less=1, $26,070 - $34,090=2, $34,091 - $42,112=3, $42,113 - $50,113=4, $50,114 - $58,154=5, $58,155 - $66,176=6, $66,177 - $67,680=7, $67,681 - $69,184=8, $69,185 - $70,688=9, $70,689 - $72,192=10, $72,193 - $73,669=11, $73,670 - $75,200=12, $75,201 or more=13

[j] Non-NC Pre-K=0, NC Pre-K=1

Table 8. Full Sample Regression Results – Math, Executive Function, and Classroom Behavior

	Math						Executive Function				Behavior Skills			
	WJ III Calculation n=472		WJ III Applied Problems n=511		WJ III Brief Math Composite n=510		Forward Digit Span n=512		Backward Digit Span n=512		SSiS Social Skills n=510		SSiS Problem Behaviors n=512	
	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)
Intercept	441.31	(6.51)	425.91	(5.23)	433.44	(5.16)	3.62	(0.29)	1.44	(0.22)	98.16	(5.26)	104.07	(5.18)
Child Characteristics														
Gender[b]	-3.30*	(1.65)	-2.20	(1.36)	-2.67*	(1.32)	-0.17*	(0.07)	-0.16**	(0.06)	-2.88*	(1.35)	0.34	(1.30)
Latino ethnicity[c]	1.70	(2.79)	-1.68	(2.26)	0.15	(2.22)	-0.26*	(0.12)	0.08	(0.09)	2.53	(2.26)	-4.95*	(2.21)
Race[d]	2.33	(1.83)	2.79+	(1.45)	2.57+	(1.45)	-0.11	(0.08)	0.18**	(0.06)	3.10*	(1.47)	-2.53+	(1.46)
Chronic health condition[e]	-5.01*	(2.52)	-3.96+	(2.07)	-4.57*	(2.02)	-0.07	(0.11)	-0.15+	(0.09)	-0.48	(2.05)	2.85	(1.98)
Family Characteristics														
English spoken at home[f]	-2.22+	(1.27)	0.53	(1.04)	-0.82	(1.02)	0.08	(0.06)	0.03	(0.04)	-0.98	(1.03)	1.19	(1.01)
Parent in military[g]	0.35	(2.65)	-1.91	(2.15)	-0.88	(2.11)	-0.08	(0.12)	0.02	(0.09)	0.96	(2.15)	0.94	(2.09)
Primary caregiver education[h]	3.49***	(1.02)	1.92*	(0.82)	2.68**	(0.81)	0.07	(0.05)	0.06+	(0.03)	0.19	(0.83)	-0.40	(0.80)
Family size	-2.12***	(0.63)	0.24	(0.52)	-0.92+	(0.50)	-0.03	(0.03)	-0.02	(0.02)	-0.22	(0.51)	-0.28	(0.49)
Family income[i]	3.19***	(0.83)	2.37***	(0.67)	2.75***	(0.66)	0.05	(0.04)	0.08**	(0.03)	1.48*	(0.67)	-1.73**	(0.65)
Treatment[j]	**4.16***	**(1.63)**	**2.64+**	**(1.35)**	**3.43****	**(1.31)**	**0.15***	**(0.07)**	**0.06**	**(0.06)**	**0.74**	**(1.33)**	**0.50**	**(1.28)**

[a] Significance levels are ***p< .001, **p< .01, *p< .05, +p<.10
[b] Female=0, Male=1.
[c] Non-Latino=0, Latino=1.
[d] Non-White=0, White = 1.
[e] No=0, Yes=1
[f] Never=0, Rarely=1, Sometimes=2, Frequently=3, Always=4
[g] No=0, Yes=1
[h] 8th grade or less=1, Some High School=2, High School Diploma/GED=3, AA/AS degree=4, BA/BS degree=5, MA/MS degree=6, Doctorate degree=7, N/A=8
[i] $26,069 or less=1, $26,070 - $34,090=2, $34,091 - $42,112=3, $42,113 - $50,113=4, $50,114 - $58,154=5, $58,155 - $66,176=6,
$66,177 - $67,680=7, $67,681 - $69,184=8, $69,185 - $70,688=9, $70,689 - $72,192=10, $72,193 - $73,669=11, $73,670 - $75,200=12, $75,201 or more=13
[j] Non-NC Pre-K=0, NC Pre-K=1

Figure 1. Adjusted Mean Difference in WJ III W Language and Math Scores for Full Sample
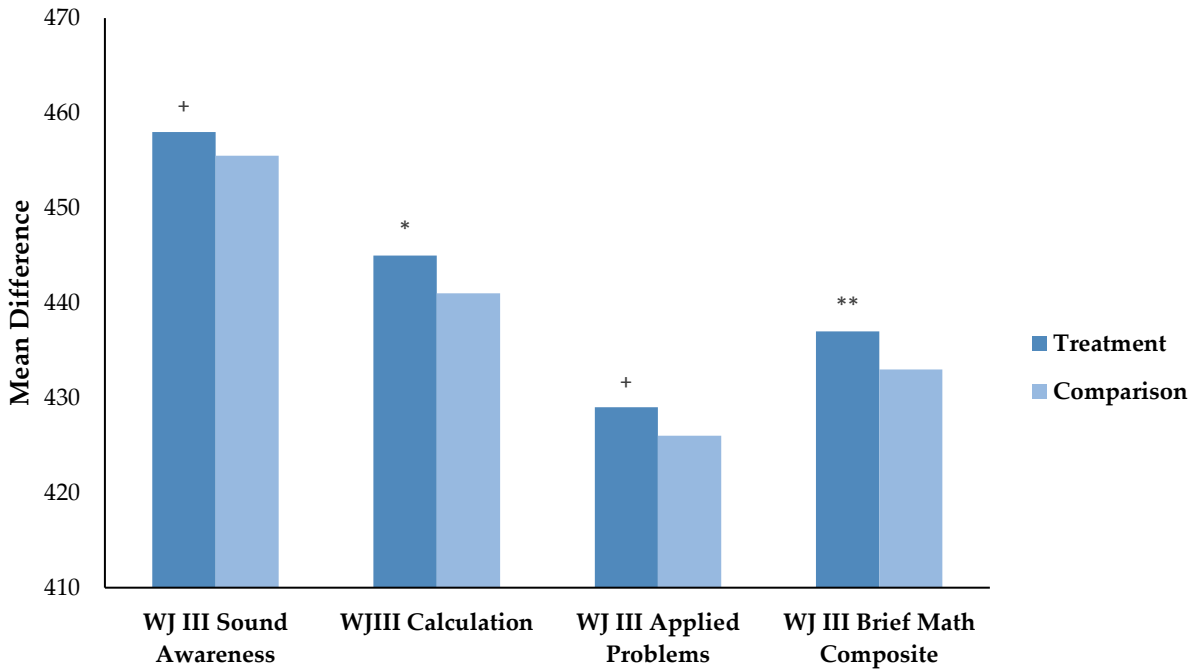
Note: ***p< .001, **p< .01, *p< .05, +p<.10

Figure 2. Adjusted Mean Differences in Forward Digit Span for Full Sample and DLL Subsample

Note: ***p< .001, **p< .01, *p< .05, +p<.10

Table 9. Kindergarten Outcome Scores for DLL Subsample – English Measures

Measure	n	All Mean (SD) Range		n	NC Pre-K Mean (SD) Range		n	Non-NC Pre-K Mean (SD) Range	
Language									
WJ III Picture Vocabulary[a]	119	80.7 (12.1) 35-105		58	82.4 (9.8) 50-100		61	79.0 (13.7) 35-105	
WJ III Sound Awareness[a]	119	94.5 (19.9) 41-141		58	97.7 (20.1) 41-133		61	91.5 (19.4) 49-141	
Literacy									
WJ III Letter-Word Identification[a]	119	109.1 (12.4) 79-152		58	108.8 (14.1) 79-152		61	109.3 (10.8) 82-133	
WJ III Word Attack[a]	119	109.4 (12.4) 68-144		58	109.1 (13.8) 68-144		61	109.6 (10.9) 78-130	
WJ III Passage Comprehension[a]	119	98.2 (13.3) 46-134		58	98.8 (14.5) 46-134		61	97.5 (12.1) 67-128	
Basic Reading Composite[a]	119	109.6 (12.2) 77-152		58	109.3 (14.1) 77-152		61	109.9 (10.3) 82-129	
Brief Reading Composite[a]	119	104.2 (13.4) 68-151		58	104.4 (14.8) 68-151		61	104.1 (12.0) 73-135	
Math									
WJ III Calculation[a]	107	106.5 (15.9) 64-137		54	106.7 (17.3) 64-137		53	106.4 (14.5) 69-131	
WJ III Applied Problems[a]	119	98.3 (13.8) 4-118		58	99.0 (16.8) 4-118		61	97.5 (10.2) 70-115	
Brief Math Composite[a]	118	101.2 (15.5) 58-134		57	103.1 (16.4) 58-134		61	99.4 (14.4) 61-124	
Executive Function									
Forward Digit Span[b]	119	3.5 (0.8) 1-6		58	3.7 (0.8) 1-5		61	3.3 (0.9) 1-6	
Backward Digit Span[b]	119	1.7 (0.7) 1-3		58	1.8 (0.6) 1-3		61	1.6 (0.7) 1-3	
Behavior Skills									
SSiS Social Skills[a]	118	100.0 (14.1) 58-126		57	102.5 (13.3) 75-121		61	97.6 (14.5) 58-126	
SSiS Problem Behaviors[a]	119	95.1 (10.9) 83-135		58	95.2 (11.5) 83-135		61	95.0 (10.5) 83-135	

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[a] Indicates standard scores on norm-referenced measure with mean=100, SD=15. WJ III scores reflect use of updated normative tables (2007).

[b] Possible range=1-8

Table 10. DLL Subsample Regression Results — English Language and Literacy Measures

| | Language | | | | Literacy | | | | | | | | |
| | WJ III Picture Vocabulary n=119 | | WJ III Sound Awareness n=119 | | WJ III Letter-Word Identification n=119 | | WJ III Word Attack n=119 | | WJ III Passage Comprehension n=119 | | WJ III Basic Reading Composite n=119 | | WJ III Brief Reading Composite n=119 | |
	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)
Intercept	436.40	(6.35)	436.54	(8.47)	389.12	(14.45)	415.17	(13.38)	405.52	(11.31)	402.33	(12.86)	396.89	(12.09)
Child Characteristics														
Gender[b]	2.06	(2.35)	1.35	(3.13)	-0.77	(5.23)	-0.12	(4.90)	-3.40	(4.20)	-0.20	(4.69)	-2.01	(4.42)
Race[c]	3.61	(2.69)	1.83	(3.58)	-5.13	(5.97)	-4.64	(5.59)	-3.26	(4.80)	-5.13	(5.36)	-4.35	(5.05)
Chronic health condition[d]	0.84	(4.33)	-9.91+	(5.77)	-13.17	(9.58)	-17.59+	(9.00)	-8.87	(7.76)	-15.48+	(8.62)	-11.34	(8.12)
Family Characteristics														
English spoken at home[e]	3.08**	(1.13)	0.91	(1.51)	0.71	(2.53)	1.11	(2.36)	0.20	(2.02)	0.87	(2.26)	0.50	(2.13)
Parent in military[f]	-2.79	(3.03)	-2.55	(4.04)	-4.31	(6.73)	-7.19	(6.31)	-4.45	(5.42)	-5.79	(6.04)	-4.34	(5.69)
Primary caregiver education[g]	0.72	(1.23)	3.51*	(1.64)	6.04*	(2.77)	5.95*	(2.58)	3.96+	(2.20)	6.03*	(2.47)	5.16*	(2.33)
Family size	1.25	(0.84)	1.36	(1.12)	-0.47	(1.86)	1.85	(1.74)	0.34	(1.50)	0.69	(1.67)	-0.01	(1.57)
Family income[h]	2.48	(1.51)	3.43+	(2.02)	6.09+	(3.36)	8.83**	(3.15)	8.32**	(2.71)	7.46*	(3.01)	7.13*	(2.84)
Treatment[i]	**3.72**	**(2.29)**	**4.97**	**(3.06)**	**2.09**	**(5.09)**	**2.01**	**(4.77)**	**3.78**	**(4.10)**	**1.70**	**(4.57)**	**2.95**	**(4.31)**

[a] Significance levels are ***p< .001, **p< .01, *p< .05, +p<.10
[b] Female=0, Male=1.
[c] Non-White=0, White = 1.
[d] No=0, Yes=1
[e] Never=0, Rarely=1, Sometimes=2, Frequently=3, Always=4
[f] No=0, Yes=1
[g] 8th grade or less=1, Some High School=2, High School Diploma/GED=3, AA/AS degree=4, BA/BS degree=5, MA/MS degree=6, Doctorate degree=7, N/A=8
[h] $26,069 or less=1, $26,070 - $34,090=2, $34,091 - $42,112=3, $42,113 - $50,113=4, $50,114 - $58,154=5, $58,155 - $66,176=6,
$66,177 - $67,680=7, $67,681 - $69,184=8, $69,185 - $70,688=9, $70,689 - $72,192=10, $72,193 - $73,669=11, $73,670 - $75,200=12, $75,201 or more=13
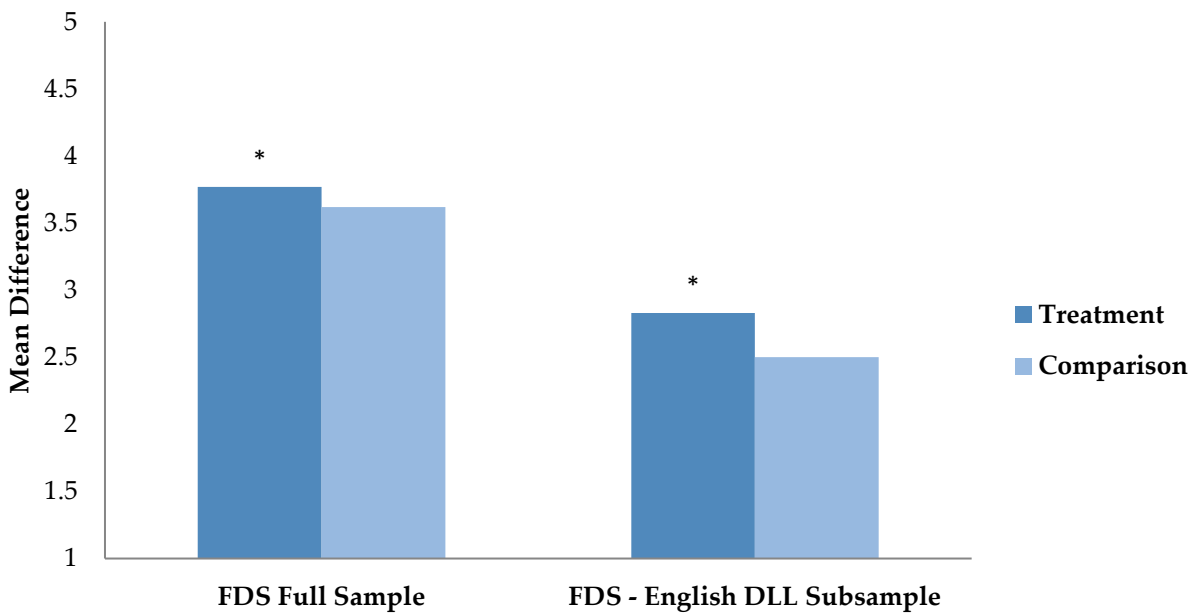[i] Non-NC Pre-K=0, NC Pre-K=1

Table 11. DLL Subsample Regression Results – English Math, Exective Function, and Classroom Behavior

	Math						Executive Function				Behavior Skills			
	WJ III Calculation n=107		WJ III Applied Problems n=119		WJ III Brief Math Composite n=118		Forward Digit Span n=119		Backward Digit Span n=119		SSiS Social Skills n=118		SSiS Problem Behaviors n=119	
	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)
Intercept	431.87	(9.97)	407.71	(9.50)	419.23	(8.47)	2.50	(0.43)	1.35	(0.35)	90.07	(7.62)	106.70	(5.79)
Child Characteristics														
Gender[b]	2.01	(3.62)	-1.10	(3.48)	0.51	(3.07)	0.25	(0.16)	-0.15	(0.13)	-2.06	(2.79)	0.40	(2.05)
Race[c]	-3.55	(4.14)	1.57	(3.98)	-0.90	(3.50)	0.22	(0.18)	0.10	(0.15)	1.27	(3.18)	0.55	(2.33)
Chronic health condition[d]	-6.53	(6.65)	-8.95	(6.41)	-7.54	(5.63)	-0.60*	(0.29)	-0.21	(0.24)	0.30	(5.11)	0.08	(3.73)
Family Characteristics														
English spoken at home[e]	-1.45	(1.75)	0.57	(1.68)	-0.35	(1.48)	0.01	(0.08)	0.04	(0.06)	-0.59	(1.34)	0.01	(0.99)
Parent in military[f]	-1.98	(4.66)	-3.85	(4.49)	-2.71	(3.95)	0.04	(0.20)	-0.04	(0.17)	1.32	(3.58)	1.12	(2.62)
Primary caregiver education[g]	4.34*	(1.91)	4.03*	(1.83)	4.21*	(1.62)	0.15+	(0.08)	0.07	(0.07)	0.67	(1.47)	-1.58	(1.09)
Family size	-1.14	(1.29)	2.02	(1.24)	0.48	(1.09)	0.04	(0.06)	0.00	(0.05)	1.06	(0.99)	-1.68*	(0.73)
Family income[h]	6.23**	(2.33)	4.51*	(2.24)	5.36**	(1.97)	0.10	(0.10)	0.08	(0.08)	1.70	(1.79)	0.35	(1.31)
Treatment[i]	**3.18**	**(3.53)**	**3.09**	**(3.40)**	**3.22**	**(2.99)**	**0.33***	**(0.15)**	**0.17**	**(0.13)**	**5.83***	**(2.72)**	**-0.44**	**(1.99)**

[a] Significance levels are ***p< .001, **p< .01, *p< .05, +p<.10
[b] Female=0, Male=1.
[c] Non-White=0, White = 1.
[d] No=0, Yes=1
[e] Never=0, Rarely=1, Sometimes=2, Frequently=3, Always=4
[f] No=0, Yes=1
[g] 8th grade or less=1, Some High School=2, High School Diploma/GED=3, AA/AS degree=4, BA/BS degree=5, MA/MS degree=6, Doctorate degree=7, N/A=8
[h] $26,069 or less=1, $26,070 - $34,090=2, $34,091 - $42,112=3, $42,113 - $50,113=4, $50,114 - $58,154=5, $58,155 - $66,176=6,
$66,177 - $67,680=7, $67,681 - $69,184=8, $69,185 - $70,688=9, $70,689 - $72,192=10, $72,193 - $73,669=11, $73,670 - $75,200=12, $75,201 or more=13
[i] Non-NC Pre-K=0, NC Pre-K=1

Figure 3. Adjusted Mean Differences in Social Skills in DLL Subsample
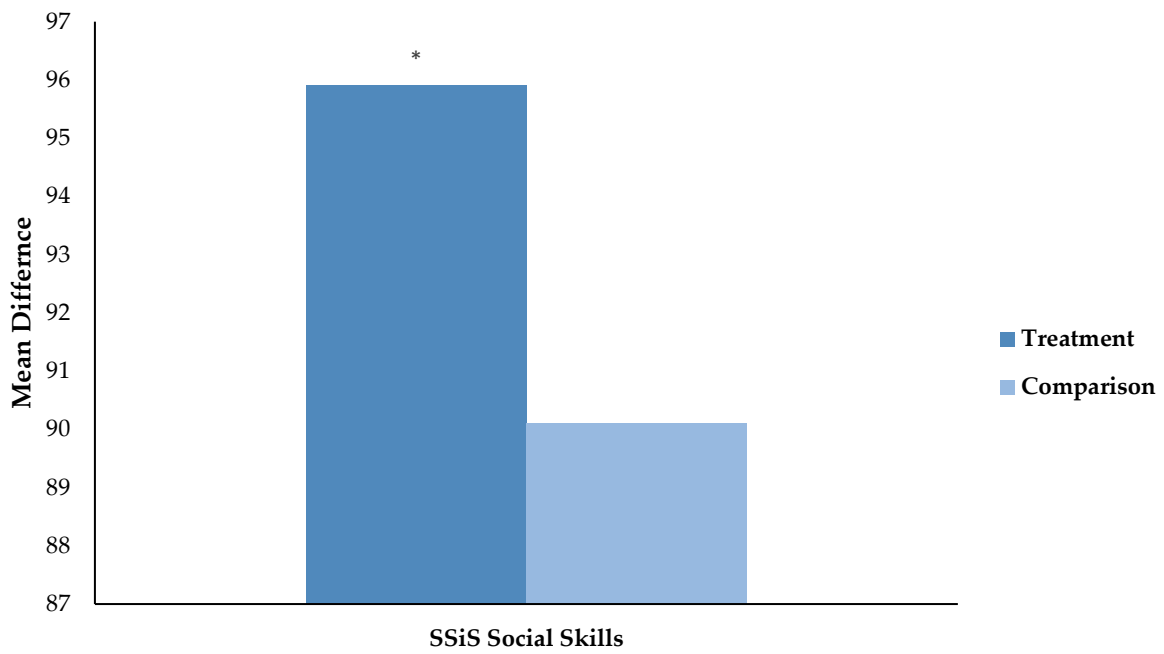
Note: ***p< .001, **p< .01, *p< .05, +p<.10

Table 12. Kindergarten Outcome Scores for DLL Subsample – Spanish Measures

Measure	All			NC Pre-K			Non-NC Pre-K		
	n	Mean	(SD)	n	Mean	(SD)	n	Mean	(SD)
		Range			Range			Range	
Language									
Bat III Picture Vocabulary[a]	119	60.5	(23.5)	58	58.5	(25.2)	61	62.4	(21.7)
		1-121			1-115			1-121	
Bat III Sound Awareness[a]	119	82.2	(19.8)	58	82.7	(20.4)	61	81.7	(19.4)
		39-123			39-123			46-123	
Literacy									
Bat III Letter-Word Identification[a]	119	91.6	(23.5)	58	91.5	(25.7)	61	91.8	(21.5)
		55-176			55-176			60-158	
Bat III Word Attack[a]	119	94.3	(17.0)	58	94.3	(18.8)	61	94.3	(15.3)
		66-159			66-159			69-139	
Bat III Passage Comprehension[a]	119	84.2	(20.2)	58	82.8	(22.1)	61	85.5	(18.2)
		43-139			43-139			47-121	
Bat III Basic Reading Composite[a]	119	92.2	(20.9)	58	92.0	(23.0)	61	92.3	(18.9)
		61-172			61-172			65-150	
Bat III Brief Reading Composite[a]	119	63.7	(27.8)	58	64.0	(25.5)	61	63.5	(30.0)
		0-99			0-95			1-99	
Math									
Bat III Calculation[a]	119	84.9	(33.1)	58	86.0	(34.5)	61	83.9	(31.9)
		6-135			6-135			19-132	
Bat III Applied Problems[a]	119	93.6	(16.8)	58	92.4	(18.1)	61	94.7	(15.4)
		12-129			27-129			12-116	
Bat III Brief Math Composite[a]	119	84.2	(27.4)	58	84.2	(29.5)	61	84.3	(25.6)
		5-133			5-133			29-123	
Executive Function									
Forward Digit Span[b]	119	3.3	(0.8)	58	3.4	(0.9)	61	3.3	(0.8)
		1-5			1-5			1-5	
Backward Digit Span[b]	119	1.8	(0.5)	58	1.8	(0.5)	61	1.8	(0.5)
		1-3			1-3			1-3	

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[a] Indicates standard scores on norm-referenced measure with mean=100, SD=15. Bat III scores reflect use of updated normative tables (2007).

[b] Possible range=1-8

Table 13. DLL Subsample Regression Results —Spanish Language and Literacy

| | Language | | | | Literacy | | | | | | | | |
	Bat III Picture Vocabulary n=119		Bat III Sound Awareness n=119		Bat III Letter-Word Identification n=119		Bat III Word Attack n=119		Bat III Passage Comprehension n=119		Bat III Basic Reading Composite n=119		Bat III Brief Reading Composite n=119	
	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)
Intercept	470.96	(11.03)	432.99	(8.42)	382.86	(25.11)	413.12	(17.07)	397.05	(18.34)	398.10	(20.56)	389.77	(20.14)
Child characteristics														
Gender[b]	-10.19*	(4.00)	-4.83	(3.18)	-14.10	(8.87)	-11.45+	(6.09)	0.36	(6.94)	-12.77+	(7.28)	-6.95	(7.22)
Race[c]	-0.10	(4.56)	0.89	(3.64)	-14.44	(10.07)	-8.97	(6.92)	-3.98	(7.93)	-11.67	(8.27)	-9.85	(8.22)
Chronic health condition[d]	-12.90+	(7.33)	-6.63	(5.90)	-1.62	(16.12)	-4.75	(11.09)	4.73	(12.85)	-3.10	(13.25)	0.13	(13.18)
Family Characteristics														
English spoken at home[e]	-10.78***	(1.93)	-1.52	(1.53)	-14.39**	(4.30)	-6.92*	(2.95)	-4.44	(3.33)	-10.79**	(3.53)	-9.01*	(3.49)
Parent in military[f]	-6.99	(5.15)	-1.71	(4.09)	-6.33	(11.32)	-9.11	(7.79)	-4.52	(8.92)	-7.68	(9.31)	-6.84	(9.26)
Primary caregiver education[g]	2.08	(2.11)	5.18**	(1.65)	5.64	(4.70)	5.37+	(3.23)	2.09	(3.59)	5.49	(3.86)	4.17	(3.83)
Family size	-3.92**	(1.43)	1.03	(1.13)	-6.29*	(3.15)	-2.14	(2.16)	-0.51	(2.47)	-4.23	(2.59)	-3.26	(2.57)
Family income[h]	6.13*	(2.57)	4.52*	(2.06)	18.78**	(5.68)	12.50**	(3.90)	9.89*	(4.50)	15.70**	(4.67)	13.71**	(4.63)
Treatment[i]	**-6.28**	**(3.90)**	**1.32**	**(3.11)**	**5.09**	**(8.62)**	**4.32**	**(5.92)**	**-4.62**	**(6.78)**	**4.70**	**(7.08)**	**-0.71**	**(7.02)**

[a] Significance levels are ***p< .001, **p< .01, *p< .05, +p<.10
[b] Female=0, Male=1.
[c] Non-White=0, White = 1.
[d] No=0, Yes=1
[e] Never=0, Rarely=1, Sometimes=2, Frequently=3, Always=4
[f] No=0, Yes=1
[g] 8th grade or less=1, Some High School=2, High School Diploma/GED=3, AA/AS degree=4, BA/BS degree=5, MA/MS degree=6, Doctorate degree=7, N/A=8
[h] $26,069 or less=1, $26,070 - $34,090=2, $34,091 - $42,112=3, $42,113 - $50,113=4, $50,114 - $58,154=5, $58,155 - $66,176=6,
$66,177 - $67,680=7, $67,681 - $69,184=8, $69,185 - $70,688=9, $70,689 - $72,192=10, $72,193 - $73,669=11, $73,670 - $75,200=12, $75,201 or more=13
[i] Non-NC Pre-K=0, NC Pre-K=1

Table 14. DLL Subsample Regression Results —Spanish Math and Executive Function

	Math						Executive Function			
	Bat III Calculation n=119		Bat III Applied Problems n=119		Bat III Brief Math Composite n=119		Forward Digit Span n=119		Backward Digit Span n=119	
	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)	Est[a]	(SE)
Intercept	388.02	(21.40)	417.35	(11.84)	404.18	(13.74)	2.30	(0.43)	1.34	(0.26)
Child Characteristics										
Gender[b]	-4.83	(7.84)	-9.63*	(4.37)	-7.30	(5.09)	0.08	(0.16)	-0.08	(0.10)
Race[c]	-12.29	(8.95)	0.82	(5.00)	-5.92	(5.82)	0.05	(0.18)	0.04	(0.11)
Chronic health condition[d]	-4.99	(14.41)	-21.55**	(8.06)	-13.71	(9.39)	-0.05	(0.30)	-0.07	(0.18)
Family Characteristics										
English spoken at home[e]	2.08	(3.78)	-1.98	(2.11)	-0.07	(2.45)	-0.05	(0.08)	-0.02	(0.05)
Parent in military[f]	-8.57	(10.10)	-1.76	(5.64)	-5.43	(6.56)	-0.13	(0.21)	-0.04	(0.12)
Primary caregiver education[g]	5.46	(4.12)	6.00*	(2.29)	5.59*	(2.66)	0.27**	(0.08)	0.14**	(0.05)
Family size	0.78	(2.79)	-0.13	(1.56)	0.15	(1.81)	0.07	(0.06)	0.02	(0.03)
Family income[h]	10.90*	(5.04)	6.03*	(2.82)	8.47*	(3.28)	0.12	(0.10)	0.07	(0.06)
Treatment[i]	**6.22**	**(7.64)**	**-2.47**	**(4.27)**	**1.63**	**(4.97)**	**0.06**	**(0.16)**	**0.09**	**(0.09)**

[a] Significance levels are ***$p< .001$, **$p< .01$, *$p< .05$, +$p<.10$
[b] Female=0, Male=1.
[c] Non-White=0, White = 1.
[d] No=0, Yes=1
[e] Never=0, Rarely=1, Sometime=2, Frequently=3, Always=4
[f] No=0, Yes=1
[g] 8th grade or less=1, Some High School=2, High School Diploma/GED=3, AA/AS degree=4, BA/BS degree=5, MA/MS degree=6, Doctorate degree=7, N/A=8
[h] $26,069 or less=1, $26,070 - $34,090=2, $34,091 - $42,112=3, $42,113 - $50,113=4, $50,114 - $58,154=5, $58,155 - $66,176=6,
$66,177 - $67,680=7, $67,681 - $69,184=8, $69,185 - $70,688=9, $70,689 - $72,192=10, $72,193 - $73,669=11, $73,670 - $75,200=12, $75,201 or more=13
[i] Non-NC Pre-K=0, NC Pre-K=1

Table 15. NC Pre-K Program Characteristics (2015–2016)

Program Characteristic		
Total NC Pre-K Sites (Centers/Schools)	n=1,157	
Total NC Pre-K Classrooms	n=1,962	
Total Children Served	n=28,757	
	Mean	(SD)
Class Size	15.8	(3.4)
Number of NC Pre-K Children per Class	13.2	(4.4)
Proportion of NC Pre-K Children per Class	0.8	(0.2)
Days of Attendance per Child	140	(39.0)
Days of Operation	173	(12.2)
Licensing Star Ratings	%	n
Five-Star	78.3	906
Four-Star	17.2	199
Temporary	0.9	10
Public School in Process	3.6	42

Table 16. NC Pre-K Classrooms: Curricula, Assessment Tools, and Developmental Screening Tools (2015–2016)

Educational Resources	n=1,962	%	n
Primary Curriculum			
Creative Curriculum		88.2	1,730
OWL		6.7	132
HighScope		3.5	68
Tools of the Mind		1.2	24
Bank Street		0.1	1
Passports: Experiences for Pre-K Success		0.2	3
Not reported		0.2	4
Ongoing Assessment Tool			
Teaching Strategies Gold/Creative Curriculum Assessment		90.3	1,772
Work Sampling System		4.9	96
HighScope Preschool Child Observation Record (COR)		3.4	67
Galileo Online Assessment System		1.0	19
Investigator Club		0.2	3
Learning Accomplishment Profile-3rd Edition		0.2	4
Parents Progress Report		0.1	1
Developmental Screening Tool			
Developmental Indicators for the Assessment of Learning (DIAL)		56.6	1,111
Brigance		34.2	670
Ages & Stages Questionnaire (ASQ)		6.7	132
Parents' Evaluation of Developmental Status (PEDS)		2.5	49

Table 17. Distribution of NC Pre-K Classrooms by Setting Type (2015–2016)

Setting Type	n=1,962	%	n
Public Preschool		51.6	1,013
Private		32.9	645
Private For-Profit		25.2	494
Private Non-Profit		7.7	151
Head Start		15.5	304
Head Start Not Administered by Public School		10.7	209
Head Start Administered by Public School		4.8	95

Table 18. Characteristics of NC Pre-K Children (2015–2016)

Characteristic n=28,757	%/Mean	n
Child's age on 8/31 of program year	4.4	28,757
Gender		
Male	50.9%	14,629
Female	49.1%	14,128
Race		
White/European-American	48.6%	13,976
Black/African-American	36.1%	10,366
Native American/Alaskan Native	5.5%	1,581
Multiracial	6.8%	1,940
Asian	2.0%	588
Native Hawaiian/Pacific Islander	1.1%	306
Ethnicity		
Non-Hispanic/Latino	75.4%	21,670
Hispanic/Latino	24.6%	7,087
Parents Employed		
Mother	48.9%	14,074
Father	41.8%	12,010
Mother or Father	77.0%	22,132

Table 19. Eligibility Factors for NC Pre-K Children (2015–2016)

Eligibility Factors[a] n=28,757	%	n
Family Income		
130% of poverty and below (eligible for free lunch)	74.3	21,376
131–185% of poverty (eligible for reduced-price lunch)	15.6	4,478
186–200% of poverty	2.8	808
201–250% of poverty	3.5	993
>251% of poverty	3.8	1,102
Limited English Proficiency		
Family and/or child speak limited or no English in the home	19.4	5,572
Educational Need		
Educational need indicated by performance on a developmental screen	23.2	6,667
Identified Disability		
Child has an IEP	4.6	1,333
Chronic Health Condition(s)		
Child is chronically ill/medically fragile	5.8	1,659
Military Parent	5.7	1,650

[a] Children are eligible for the NC Pre-K Program primarily based on age and family income. Children must be four years old by August 31 of the program year, with a gross family income up to 75% of state median income. Children who do not meet the income eligibility may be eligible if they have at least one of the following: limited English proficiency, identified disability, chronic health condition, educational need, or a parent serving in the military.

Table 20. Prior Placement for NC Pre-K Children (2015–2016)

Prior Placement n=28,757	%	n
Children who have never been served in any preschool or child care setting.	59.4	17,069
Children who are currently unserved (may previously have been in preschool or child care setting).	14.4	4,131
Children who are in unregulated child care.	1.8	509
Children who are in a regulated preschool or child care setting, but are not receiving subsidy.	15.5	4,460
Children who are receiving subsidy and are in some kind of regulated child care or preschool program.	8.6	2,474
Not reported	0.4	114

Table 21. Education Levels of NC Pre-K Lead Teachers (2015–2016)

Setting Type[a]	Total n	MA/MS or higher		BA/BS		AA/AAS		HS diploma/GED	
		%	n	%	n	%	n	%	n
Public School	1,125	18.3	206	81.4	916	0.0	0	0.3	3
Private	881	10.1	89	89.7	790	0.1	1	0.1	1
All	2,006[b]	14.7	295	85.0	1,706	0.0	1	0.2	4

Table 22. Licensure/Credential Levels of NC Pre-K Lead Teachers (2015–2016)

Setting Type[a]	Total n	B-K[d]		Other Teacher's License		CDA Credential		NCECC		None	
		%	n	%	n	%	n	%	n	%	n
Public School	1,125	96.0	1,080	2.7	30	0.0	0	0.0	0	1.3	15
Private	881	76.7	676	4.2	37	0.6	5	2.2	19	16.4	144
All	2,006[b]	87.5	1,756	3.3	67	0.2	5	0.9	19	7.9	159

[a] Teachers in Head Start classrooms administered by public schools are included in public school setting types; teachers in Head Start classrooms not administered by public schools are included in private setting types.

[b] Data were not reported for 2 teachers.

[c] Note: B-K = Birth-Kindergarten, CDA = Child Development Associate, NCECC = North Carolina Early Childhood Credential. Other teacher's license includes non-early childhood licenses and licenses from other states.

[d] This category includes teachers with a NC B-K license, NC B-K Standard Professional I or II, NC Lateral Entry Provisional B-K license, NC Provisional B-K license, or Preschool Add-on.

Table 23. Pre-K Classrooms by Setting Type (2003-04 – 2015-16)

Setting Type	2003–2004 n=866	2004–2005 n=1,027	2005–2006 n=1,218	2006–2007 n=1,439	2007–2008 n=2,110	2008–2009 n=2,322	2009–2010 n=2,308	2010–2011 n=2,262	2011–2012 n=2,057	2012-2013 n=2,150	2013-2014 n=1,993	2014-2015 n=1,974	2015-2016 n=1,962
Public Preschool	**49.7%** **(430)**	**54.1%** **(556)**	**53.0%** **(646)**	**55.0%** **(791)**	**53.4%** **(1,127)**	**51.9%** **(1,205)**	**52.2%** **(1,205)**	**54.1%** **(1,223)**	**50.6%** **(1,041)**	**50.7%** **(1,090)**	**54.2%** **(1,080)**	**51.6%** **(1,019)**	**51.6%** **(1,013)**
Private	**35.2%** **(305)**	**34.8%** **(357)**	**35.1%** **(427)**	**32.0%** **(461)**	**28.5%** **(602)**	**28.8%** **(669)**	**28.1%** **(649)**	**27.1%** **(613)**	**33.3%** **(686)**	**33.5%** **(719)**	**31.9%** **(636)**	**33.2%** **(655)**	**32.9%** **(645)**
Private For-Profit	25.1% (217)	24.1% (247)	23.6% (287)	21.3% (306)	19.4% (409)	20.1% (467)	19.3% (446)	18.7% (424)	24.2% (497)	24.3% (522)	23.4% (466)	24.9% (491)	25.2% (494)
Private Non-Profit	10.2% (88)	10.7% (110)	11.5% (140)	10.8% (155)	9.1% (193)	8.7% (202)	8.8% (203)	8.4% (189)	9.2% (189)	9.2% (197)	8.5% (170)	8.3% (164)	7.7% (151)
Head Start	**15.1%** **(131)**	**11.1%** **(114)**	**11.9%** **(145)**	**13.0%** **(187)**	**18.1%** **(381)**	**19.3%** **(448)**	**19.7%** **(454)**	**18.8%** **(426)**	**16.0%** **(330)**	**15.8%** **(341)**	**13.9%** **(277)**	**15.2%** **(300)**	**15.5%** **(304)**
Head Start Not Administered by Public School	9.2% (80)	8.4% (86)	9.0% (110)	10.1% (145)	14.8% (313)	15.8% (366)	15.8% (364)	14.9% (338)	12.4% (256)	12.8% (276)	10.6% (212)	10.6% (209)	10.7% (209)
Head Start Administered by Public School	5.9% (51)	2.7% (28)	2.9% (35)	2.9% (42)	3.2% (68)	3.5% (82)	3.9% (90)	3.9% (88)	3.6% (74)	3.0% (65)	3.3% (65)	4.6% (91)	4.8% (95)

Table 24. Prior Placement of Pre-K Children (2003-04 – 2015-16)

Prior Placement	2003–2004 n=10,891	2004–2005 n=13,515	2005–2006 n=17,251	2006–2007 n=20,468	2007–2008 n=29,978	2008–2009 n=33,798	2009–2010 n=34,212	2010–2011 n=33,747	2011–2012 n=29,311	2012-2013 n=32,142	2013-2014 n=29,346	2014-2015 n=29,271	2015-2016 n=28,757
Children who have never been served in any preschool or child care setting.	62.3% (6,788)	60.4% (8,165)	59.9% (10,325)	58.8% (12,033)	54.6% (16,353)	54.0% (18,237)	54.8% (18,755)	57.5% (19,397)	59.6% (17,484)	59.5% (19,120)	61.7% (18,111)	57.7% (16,904)	59.4% (17,069)
Children who are currently unserved (may previously have been in preschool or child care setting).[a]	20.9% (2,282)	17.9% (2,418)	13.2% (2,270)	13.1% (2,676)	13.1% (3,938)	16.1% (5,433)	15.1% (5,155)	14.6% (4,918)	17.9% (5,234)	19.2% (6,181)	16.1% (4,729)	13.9% (4,055)	14.4% (4,131)
Children who are in unregulated child care.	--	4.5% (608)	4.2% (716)	4.0% (814)	5.3% (1,592)	5.9% (1,981)	4.7% (1,609)	3.8% (1,291)	2.8% (810)	2.0% (647)	1.8% (520)	2.2% (646)	1.8% (509)
Children who are in a regulated preschool or child care setting, but are not receiving subsidy.	5.6% (606)	3.4% (463)	2.1% (364)	2.4% (497)	3.6% (1,072)	4.5% (1,510)	4.7% (1,612)	5.2% (1,765)	13.5% (3,955)	12.0% (3,845)	13.4% (3,928)	17.2% (5,022)	15.5% (4,460)
Children who are receiving subsidy and are in some kind of regulated child care or preschool program	--	--	--	--	--	--	--	--	6.2% (1,828)	7.3% (2,349)	7.0% (2,058)	8.8% (2,575)	8.6% (2,474)
Children served for 5 months or less in the year prior to service in the More at Four program in any preschool or child care setting.	--	3.2% (436)	5.9% (1,022)	4.1% (849)	3.9% (1,161)	2.3% (780)	2.1% (721)	1.5% (520)	--	--	--	--	--
Other children, including those in pre-kindergartens or child care settings that do not meet More at Four program standards.	11.2% (1,215)	10.5% (1,425)	7.2% (1,236)	7.2% (1,474)	8.5% (2,556)	4.6% (1,570)	4.4% (1,507)	4.5% (1,527)	--	--	--	--	--
Children served by this site as 3-year-olds.	--	--	7.6% (1,318)	10.4% (2,125)	11.0% (3,306)	12.7% (4,287)	14.2% (4,853)	12.8% (4,329)	--	--	--	--	--

[a] This category included two separate categories indicating children's eligibility for subsidy prior to 2007–2008.

Table 25. Education Levels of Pre-K Lead Teachers (2003-04 – 2015-16)

Setting Type[a]	Total n[b]	MA/MS or higher		BA/BS		AA/AAS		HS diploma/GED	
		%	n	%	n	%	n	%	n
2003–2004									
Public School	450	17.1	77	77.1	347	2.4	11	3.3	15
Private	534	4.1	22	62.5	334	25.3	135	8.1	43
All	984	10.1	99	69.2	681	14.8	146	5.9	58
2004–2005									
Public School	615	15.1	93	83.6	514	1.0	6	0.3	2
Private	519	4.2	22	61.3	318	29.5	153	5.0	26
All	1,133	10.2	115	73.3	831	14.0	159	2.5	28
2005–2006									
Public School	725	13.8	100	84.6	613	1.4	10	0.3	2
Private	620	3.4	21	61.0	378	31.8	197	3.9	24
All	1,342	9.0	121	73.7	989	15.4	206	1.9	26
2006–2007									
Public School	875	15.1	132	84.0	735	0.8	7	0.1	1
Private	684	4.4	30	57.9	396	34.2	234	3.5	24
All	1,555	10.4	162	72.5	1,128	15.4	240	1.6	25
2007–2008									
Public School	1,197	13.8	165	84.5	1,012	1.5	18	0.2	2
Private	990	3.8	38	50.0	495	41.8	414	4.3	43
All	2,183	9.3	203	68.9	1,503	19.8	432	2.1	45
2008–2009									
Public School	1,305	14.9	195	83.5	1,090	1.4	18	0.2	2
Private	1,109	4.2	47	52.4	581	41.3	458	2.1	23
All	2,409	10.0	241	69.2	1,667	19.8	476	1.0	25
2009–2010									
Public School	1,308	15.3	200	83.0	1,085	1.8	23	0.0	0
Private	1,107	5.3	59	62.2	689	31.7	351	0.7	8
All	2,412	10.7	259	73.5	1,772	15.5	373	0.3	8
2010–2011									
Public School	1,333	16.0	213	82.9	1,105	1.1	15	0.0	0
Private	1,065	7.2	77	73.9	787	18.8	200	0.1	1
All	2,395	12.1	289	78.9	1,889	9.0	216	0.0	1
2011–2012									
Public School	1,142	15.8	181	83.7	956	0.4	5	0.0	0
Private	1,054	8.6	91	87.3	920	3.6	38	0.5	5
All	2,191	12.4	271	85.4	1,872	2.0	43	0.2	5
2012-2013									
Public School	1,191	16.3	194	83.5	995	0.2	2	0.0	0
Private	1,064	7.9	84	89.9	957	2.1	22	0.1	1
All	2,255	12.3	278	86.6	1,952	1.1	24	0.0	1

[a] Teachers in Head Start classrooms administered by public schools are included in public school setting types; teachers in Head Start classrooms not administered by public schools are included in private setting types.

[b] In some cases, the *n* for All is less than the sum of the *n*'s for Public School and Private because some teachers worked in both public and private settings (n=1 in 2004–2005; n=3 in 2005–2006 and 2009–2010; n=4 in 2006–2007, 2007–2008, and 2010–2011; and n=5 in 2008–2009 and 2011–2012).

Table 25. Education Levels of Pre-K Lead Teachers (2003-04 – 2015-16)

| Setting Type[a] | Total n[b] | Highest Education Level | | | | | | | |
| | | MA/MS or higher | | BA/BS | | AA/AAS | | HS diploma/GED | |
		%	n	%	n	%	n	%	n
2013–2014									
Public School	1,168	15.4	180	84.4	985	0.2	2	0.0	0
Private	932	11.2	104	88.0	819	1.0	9	0.0	0
All	2,099	13.6	285	85.9	1,803	0.5	11	0.0	0
2014-2015									
Public School	1,149	19.4	223	80.4	924	0.1	1	0.1	1
Private	911	10.0	92	90.0	819	0.0	0	0.0	0
All	2,060	15.3	315	84.7	1,743	0.0	1	0.0	1
2015-2016									
Public School	1,125	18.3	206	81.4	916	0.0	0	0.3	3
Private	881	10.1	89	89.7	790	0.1	1	0.1	1
All	2,006	14.7	295	85.0	1,706	0.0	1	0.2	4

Table 26. Licensure/Credential Levels of Pre-K Lead Teachers (2003-04 – 2015-16)

Setting Type[c]	Total n[d]	B-K License[b]		Other Teacher's License		CDA Credential		NCECC		None	
		%	n	%	n	%	n	%	n	%	n
2003–2004											
Public School	454	68.1	309	18.3	83	0.0	0	1.1	5	12.6	57
Private	535	16.4	88	10.5	56	3.9	21	16.3	87	52.9	283
All	989	40.1	397	14.1	139	2.1	21	9.3	92	34.4	340
2004–2005											
Public School	615	75.4	464	13.5	83	0.7	4	1.1	7	9.3	57
Private	519	15.2	79	9.1	47	9.6	50	28.9	150	37.2	193
All	1,133	47.8	542	11.5	130	4.8	54	13.9	157	22.1	250
2005–2006											
Public School	725	83.1	601	9.8	71	0.6	4	1.1	8	5.7	41
Private	620	16.5	103	8.5	53	6.5	40	31.5	195	36.9	229
All	1,342	52.3	702	9.2	124	3.3	44	15.1	202	20.0	269
2006–2007											
Public School	875	86.2	753	8.0	70	0.6	5	1.3	11	4.1	36
Private	684	20.6	142	7.5	51	5.6	38	32.3	221	33.9	232
All	1,555	57.4	893	7.7	120	2.8	43	14.9	231	17.2	268
2007–2008											
Public School	1,197	85.7	1,025	7.2	86	0.9	11	1.1	13	5.2	62
Private	990	17.1	172	5.7	56	6.5	64	37.9	375	32.6	323
All	2,183	54.7	1,194	6.5	142	3.4	75	17.7	387	17.6	385
2008–2009											
Public School	1,305	86.8	1,134	7.5	98	0.6	8	1.2	16	3.8	49
Private	1,109	22.7	256	5.8	64	4.4	49	39.2	435	27.5	305
All	2,409	57.5	1,385	6.7	162	2.4	57	18.7	451	14.7	354
2009–2010											
Public School	1,308	88.5	1,156	7.0	91	0.5	6	1.9	25	2.3	30
Private	1,107	30.8	341	7.6	84	4.6	51	32.9	364	24.1	267
All	2,412	62.0	1,496	7.3	175	2.3	56	16.1	388	12.3	297

[a] Note: B-K = Birth-Kindergarten, CDA = Child Development Associate, NCECC = North Carolina Early Childhood Credential. Other teacher's license includes non-early childhood licenses and licenses from other states.

[b] This category includes teachers with a NC B-K license, NC B-K Standard Professional I or II, NC Lateral Entry Provisional B-K license, NC Provisional B-K license, or Preschool Add-on.
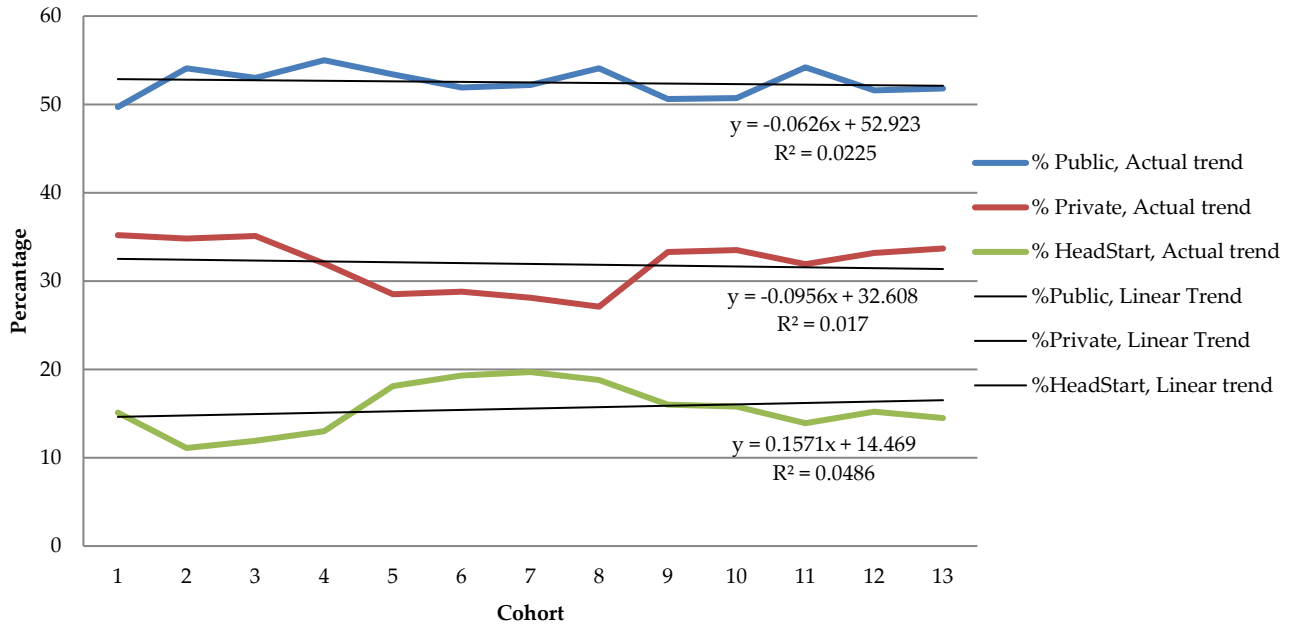
[c] Teachers in Head Start classrooms administered by public schools are included in public school setting types; teachers in Head Start classrooms not administered by public schools are included in private setting types.

[d] In some cases, the *n* for All is less than the sum of the *n*'s for Public School and Private because teachers worked in both setting types (n=1 in 2004–2005; n=3 in 2005–2006 and 2009–2010; n=4 in 2006–2007, 2007–2008, and 2010–2011; and n=5 in 2008–2009 and 2011–2012).
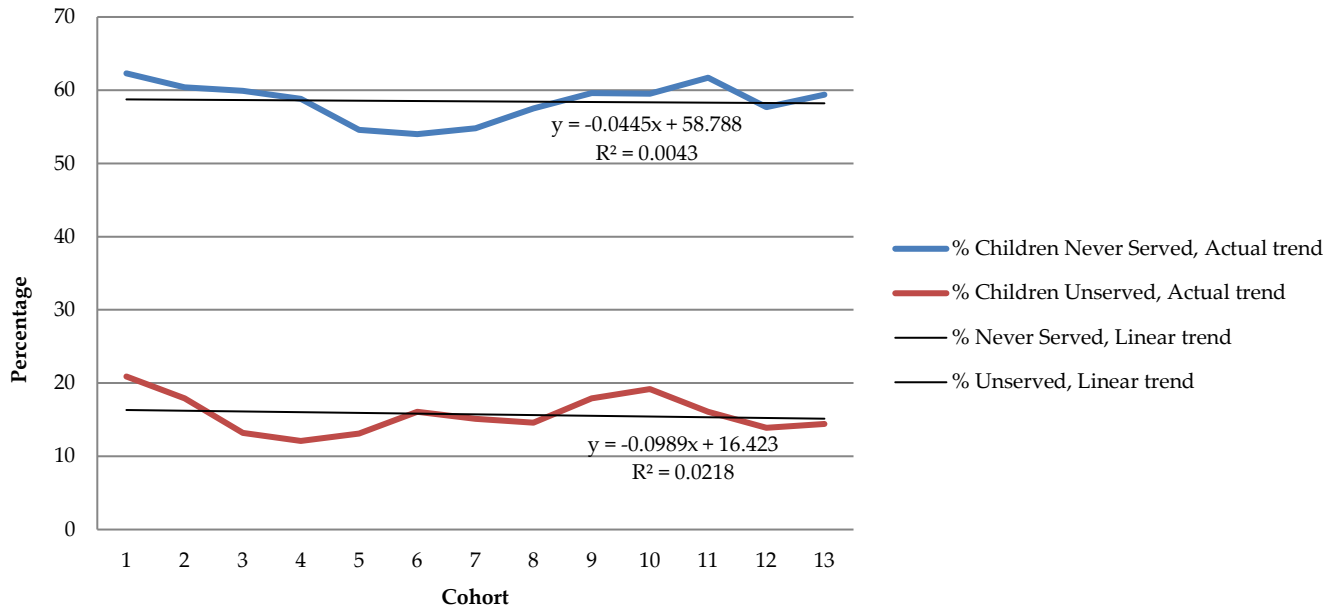
Table 26. Licensure/Credential Levels of Pre-K Lead Teachers (2003-04 – 2015-16)

Setting Type[c]	Total n[d]	B-K License[b]		Other Teacher's License		CDA Credential		NCECC		None	
		%	n	%	n	%	n	%	n	%	n
2010–2011											
Public School	1,333	92.8	1,237	4.6	61	0.2	3	1.3	17	1.1	15
Private	1,065	44.0	471	9.2	98	2.9	31	22.6	241	21.0	224
All	2,394	71.2	1,704	6.6	159	1.4	34	10.8	259	10.0	239
2011–2012											
Public School	1,142	91.3	1,043	6.0	68	0.1	1	0.7	8	1.9	22
Private	1,054	51.0	538	11.0	116	1.4	15	12.9	135	23.7	250
All	2,191	72.0	1,578	8.4	183	0.7	16	6.5	143	12.4	271
2012–2013											
Public School	1,191	92.9	1,106	4.9	58	0.1	1	0.3	3	1.9	23
Private	1,064	57.0	606	9.0	96	0.9	10	11.2	119	21.9	233
All	2,255	75.9	1,712	6.8	154	0.5	11	5.4	122	11.4	256
2013–2014											
Public School	1,168	93.7	1,093	5.1	59	0.1	1	0.1	1	1.2	14
Private	932	63.8	594	10.5	98	0.9	8	6.3	59	18.6	173
All	2,099	80.3	1,686	7.5	157	0.4	9	2.9	60	8.9	187
2014-2015											
Public School	1,149	91.7	1,054	1.7	20	0.0	0	0.5	6	6.0	69
Private	911	74.5	679	6.3	57	0.1	1	4.3	39	14.8	135
All	2,060	84.1	1,733	3.8	77	0.0	1	2.2	45	9.9	204
2015-2016											
Public School	1,125	96.0	1,080	2.7	30	0.0	0	0.0	0	1.3	15
Private	881	76.7	676	4.2	37	0.6	5	2.2	19	16.3	144
All	2,006	87.5	1,756	3.3	67	0.2	5	0.9	19	7.9	159

Highest Licensure/Credential[a]

Figure 4. NC Pre-K Setting Types by Cohort
(2003-2004 – 2015-2016)

$y = -0.0626x + 52.923$
$R^2 = 0.0225$

$y = -0.0956x + 32.608$
$R^2 = 0.017$

$y = 0.1571x + 14.469$
$R^2 = 0.0486$

— % Public, Actual trend
— % Private, Actual trend
— % HeadStart, Actual trend
— %Public, Linear Trend
— %Private, Linear Trend
— %HeadStart, Linear trend

Figure 5. Prior Placement for NC Pre-K Children by Cohort
(2003-2004 – 2015-2016)

$y = -0.0445x + 58.788$
$R^2 = 0.0043$

$y = -0.0989x + 16.423$
$R^2 = 0.0218$

— % Children Never Served, Actual trend
— % Children Unserved, Actual trend
— % Never Served, Linear trend
— % Unserved, Linear trend

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Figure 6. NC Pre-K Teacher Qualifications by Cohort
(2003-2004 - 2015-2016)

$y = 2.0621x + 74.704$
$R^2 = 0.7747$

$y = 3.8511x + 38.119$
$R^2 = 0.9738$

$y = -1.6313x + 26.712$
$R^2 = 0.7713$

Legend:
- %Teacher BA+, Actual trend
- % BK License, Actual trend
- % No credential, Actual trend
- %Teacher BA+, Linear trend
- %BK License, Linear trend
- %No credential, Linear trend

Y-axis: Percentage
X-axis: Cohort
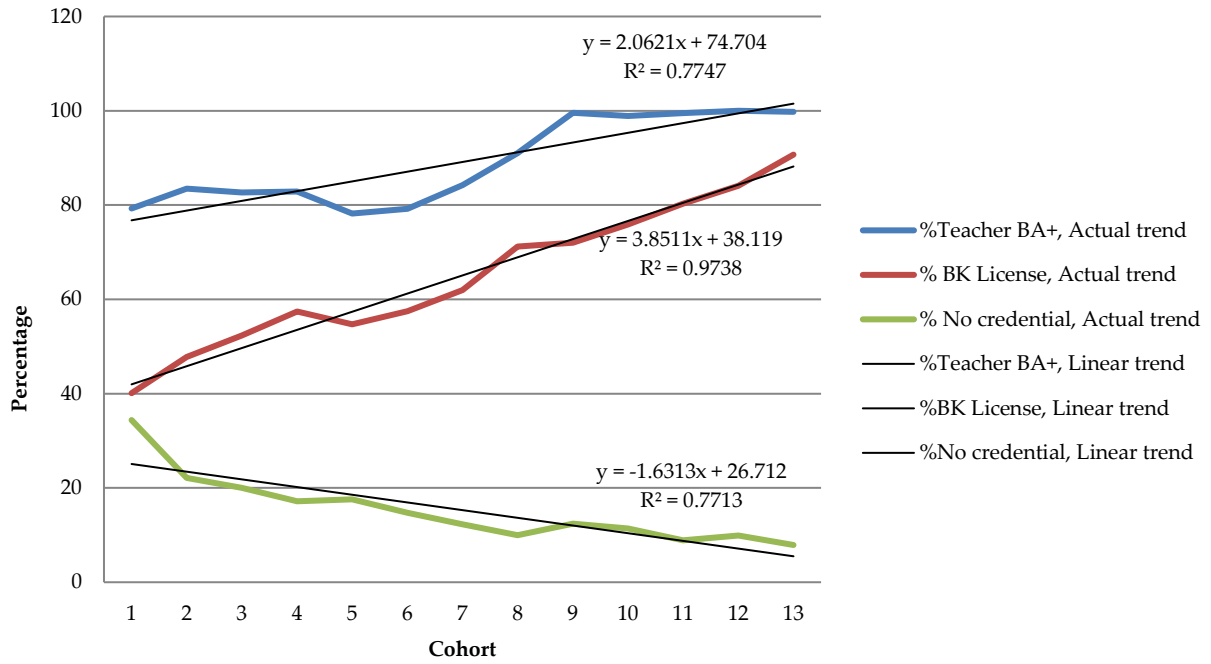
Appendix

List of NC Pre-K Evaluation Reports

Peisner-Feinberg, E. S. (2003). *Child and program characteristics of the North Carolina More at Four Pre-kindergarten Program: Year 1 (January–June 2002).* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Maris, C. L. (2005). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: Year 2 (July 1, 2002–June 30, 2003).* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Maris, C. L. (2005). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: Year 3 Report (July 1, 2003–June 30, 2004).* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Maris, C. L. (2006). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: Children's longitudinal outcomes and classroom quality in kindergarten.* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., Elander, K.C., & Maris, C. L. (2006). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: Year 4 (July 1, 2004–June 30, 2005) Program characteristics and services.* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Schaaf, J. M. (2007). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: Children's outcomes and program quality in the fifth year.* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Schaaf, J. M. (2008). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: Children's longitudinal outcomes and program quality over time (2003–2007).* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Schaaf, J.M. (2008). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: Performance and progress in the seventh year (2007–2008).* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S. & Schaaf, J. M. (2009). *Evaluation of the North Carolina More at Four Pre-kindergarten Program: A look across time at children's outcomes and classroom quality from pre-k through kindergarten (2003–2009).* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Schaaf, J.M. (2010). *Long-term effects of the North Carolina More at Four Pre-kindergarten Program: Children's reading and math skills at third grade.* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., & Schaaf, J.M. (2011). *Effects of the North Carolina More at Four Pre-kindergarten Program on children's school readiness skills Key Findings*. Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., Schaaf, J. M., Hildebrandt, L., & LaForett, D. R. (2013). *Quality and characteristics of the North Carolina Pre-Kindergarten Program: 2011–2012 Statewide evaluation.* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., LaForett, D. R. Schaaf, J. M., Hildebrandt, L. M., Sideris, J., & Pan, Y. (2014). *Children's kindergarten outcomes and program quality in the North Carolina Pre-Kindergarten Program: 2012-2013 Statewide Evaluation.* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., Schaaf, J. M., Hildebrandt, L. M., Pan, Y., & Warnaar, B. L. (2015). *Children's outcomes and program quality in the North Carolina Pre-Kindergarten Program: 2013-2014 Statewide Evaluation.* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Peisner-Feinberg, E. S., Garwood, J. D., & Mokrova, I. L. (2016). Children's pre-k experiences and outcomes in the North Carolina Pre-Kindergarten Program: 2014–2015 statewide evaluation. Chapel Hill, NC: The University of North Carolina, FPG Child Development Institute

References

i North Carolina Division of Child Development and Early Education. (2015). *NC Pre-Kindergarten (NC Pre-K) program requirements and guidance. Effective SFY 2015–2016.* Retrieved from http://ncchildcare.dhhs.state.nc.us/pdf_forms/NCPre-K_Program_Requirements_Guidance.pdf

ii North Carolina Foundations Task Force. (2013). *North Carolina foundations for early learning and development.* Raleigh, NC.

iii North Carolina Division of Child Development and Early Education. (2015). *NC Pre-Kindergarten (NC Pre-K) program fiscal and contract manual.* Retrieved from http://ncchildcare.nc.gov/pdf_forms/NCPre-K_BudgetFinancialContractManual.pdf

iv Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III Tests of Achievement*. Rolling Meadows, IL: Riverside Publishing.

v Muñoz-Sandoval, A. F., Woodcock, R. W., McGrew, K. S., & Mather, N. (2005). *Batería III Woodcock-Muñoz: Pruebas de Aprovechamiento.* Rolling Meadows, IL: Riverside Publishing.

vi Gathercole, S. E., & Pickering, S. J. (2000). Working memory deficits in children with low achievements in the national curriculum at 7 years of age. *British Journal of Education Psychology, 70,* 177-194.

vii Gresham, F., & Elliott, S. (2008). *Social Skills Improvement System*. Minneapolis, MN: Pearson.

viii Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Lawrence Erlbaum Associates.

ix Sawilowsky, S. S. (2009). New effect size rules of thumb. *Journal of Modern Applied Statistical Methods*, *8*(2), 597 – 599.

x U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, *National Assessment of Educational Progress (NAEP), 2000-2015 Mathematics Assessments*.

xi U.S. Department of Education, Institute of Education Sciences, *National Center for Education Statistics*, *National Assessment of Educational Progress (NAEP), 1998-2015 Reading Assessments*.

xii Bialystok, E. (2009). Bilingualism: The good, the bad, and the indifferent. *Bilingualism: Language and Cognition, 12,* 3–11.

xiii Crosnoe, R. (2007). Early child care and the school readiness of children from Mexican immigrant families. *International Migration Review, 41*(1), 152–181.

xiv De Feyter, J., & Winsler, A. (2009). The early developmental competencies and school readiness of low-income, immigrant children: Influences of generation, race/ethnicity, and national origins. *Early Childhood Research Quarterly*, *24*, 411–431.

[xv] Galindo, C., & Fuller, B. (2010). The social competence of Latino kindergarteners and growth in mathematical understanding. *Developmental Psychology, 46,* 579–592.

[xvi] Luchtel, M., Hughes, K., Luze, G., Bruna, K., & Peterson, C. (2010). A comparison of teacher-rated classroom conduct, social skills, and teacher-child relationship quality between preschool English learners and preschool English speakers. *NHSA Dialog, 13,* 92–111.

[xvii] Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78,* 647–663. doi: 10.1111/j.1467-8624.2007.01019.x

[xviii] Booth, J. N., Boyle, J. M. E., & Kelly, S. W. (2010). Do tasks make a difference? Accounting for heterogeneity of performance of children with reading difficulties on tasks of executive function: Findings from a meta-analysis. *British Journal of Developmental Psychology, 28,* 133–176.

[xix] Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology, 19(3),* 273–293. doi: 10.1207/S15326942DN1903_3

[xx] Lee, K., Ng, S. F., Pe, M. L., Ang, S. Y., Hasshim, M. N. A. M., & Bull, R. (2011). The cognitive underpinnings of emerging mathematical skills: Executive functioning, patterns, numeracy, and arithmetic. *British Journal of Educational Psychology, 82,* 82–99. doi:10.1111/j.2044-8279.2010.02016.x

[xxi] St. Clair-Thompson, H. L., & Gathercole, S. E. (2006). Executive functions and achievements in school: Shifting, updating, inhibition, and working memory. *Quarterly Journal of Experimental Psychology, 59,* 745–759. doi: 10.1080/17470210500162854

[xxii] van der Sluis, S., de Jong, P. F., & Van der Leij, A. (2007). Executive functioning in children, and its relations with reasoning, reading, and arithmetic. *Intelligence, 35(5),* 427–449. doi: 10.1016/j.intell.2006.09.001

[xxiii] Bull, R., Espy, K. A., & Wiebe, S. A. (2008). Short-term memory, working memory, and executive functioning in preschoolers: Longitudinal predictors of mathematical achievement at age 7 years. *Developmental Neuropsychology, 33*(3), 205–228. doi: 10.1080/87565640801982312

[xxiv] Bull, R., Espy, K. A., Wiebe, S. A., Sheffield, T. D., & Nelson, J. M. (2011). Using confirmatory factor analysis to understand executive control in preschool children: Sources of variation in emergent mathematic achievement. *Developmental Science, 14(4),* 679–692. doi: 10.1111/j.1467-7687.2010.01012.x

[xxv] Clark, C. A. C., Sheffield, T. D., Chevalier, N., Nelson, J. M., Wiebe, S. A., & Espy, K. A. (2013). Charting early trajectories of executive control with the shape school. *Developmental Psychology, 49(8),* 1481–1493. doi: 10.1037/a0030578

[xxvi] Friedman, N. P., Haberstick, B. C., Willcutt, E. G., Miyake, A., Young, S. E., Corley, R. P., et al. (2007). Greater attention problems during childhood predict poorer executive

functing in late adolescence. *Psychological Science, 18(10),* 893–900. doi: 10.1111/j.1467-9280.2007.01997.x

[xxvii] McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43(4),* 947–959. doi: 10.1037/0012-1649.43.4.947

[xxviii] Schmitt, S. A., Pratt, M. E., & McClelland, M. M. (2014). Examining the validity of behavioral self-regulation tools in predicting preschoolers' academic achievement. *Early Education and Development, 25(5),* 641–660. doi: 10.1080/10409289.2014.850397

[xxix] Welsh, J. A., Nix, R. L., Blair, C., Bierman, K. L., & Nelson, K. E. (2010). The development of cognitive skills and gains in academic school readiness for children from low-income families. *Journal of Educational Psychology, 102(1),* 43–53. doi: 10.1037/a0016738

[xxx] Magnuson, K.A. , Ruhm, C., & Waldfogel, J. (2007). Does prekindergarten improve school preparation and performance? *Economics of Education Review, 26,* 33–51.

[xxxi] Henry, G. T., Gordon, C. S., & Rickman, D. K. (2006). Early Education Policy Alternatives: Comparing Quality and Outcomes of Head Start and State Prekindergarten. *Educational Evaluation and Policy Analysis, 28* (1), 77-99.

[xxxii] Gormley, W. T., Phillips, D. A., Newmark, K., Welti, K., and Adelstein, S. (2011). Social-Emotional Effects of Early Childhood Education Programs in Tulsa. *Child Development, 82* (6), 2095–2109.