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The Relationship between Summer Child Care Experiences and Child Well Being for Young School-Age Children

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April 26, 2010

Acknowledgments: I would like to thank Greg Duncan, Mimi Engel, Larry Hedges, Jane Leber Herr, and Katherine Magnuson for helpful comments. This research was made possible by grant #90YE0088 from the Child Care Bureau, Administration for Children and Families, U.S. Department of Health and Human Services (DHHS).

Abstract

How children spend their time is important for their development. Over half of all children in the early school years participate in child care both during the school year and in the summers (Capizzano et al., 2002; Capizzano et al., 2000). Little is known about how these child care experiences relate to child development and whether or not these experiences might explain some of the well-documented summer learning differences between high- and low-income children (Cooper et al, 1996). Using a nationally representative sample, this study investigates the relationship between formal center child care during the summer prior to first grade and children's reading and math achievement test scores in the fall of first grade. Results suggest that children who attend center child care during the summer have higher reading achievement test scores in the fall of first grade, even when controlling for a host of child and family background characteristics. Center child care was not consistently related to math achievement test scores. Differences by family income are explored. Center child care appears to be most beneficial for children in the lower-income and the highest-income families. Findings suggest that promoting and improving access to formal child care during the summer for young school-age children might be beneficial to their reading skills at the start of the school year.

The Relationship between Summer Child Care Experiences and Child Well Being for Young School-Age Children

Seasonality in learning has been the focus of much policy and research for many years (Burkam et al, 2004; Cooper et al, 1996; Entwisle & Alexander, 1992). In the first years of school, children learn more slowly during the summer than during the school year (Cooper et al., Downey, von Hippel, & Broh, 2004), but as material becomes more difficult in later grades, children actually lose close to one-month's worth of material over the summer (Cooper et al., 1996). Children from economically disadvantaged families gain skills more slowly during the summer in the early grades, losing ground in both reading and math achievement to their counterparts from higher-income homes (Alexander, Entwisle. & Olson, 2001; Cooper et al, 1996; Downey et al., 2004). Several interventions and policies have been created to try to eliminate this loss including summer school, extended school years, and year-round schools, but little is known about how children's summer experiences outside of home and school relate to their academic achievement at the start of the school year.

Summer child care is one important summer experience for young school-age children. Over half of all school-age children, ages 6-9, attend non-parental child care during the summer (Capizzano, Adelman, & Stagner, 2002; Capizzano, Tout, & Adams, 2000). Finding and securing child care for this long break can be challenging for their parents (Duffet et al, 2004), particularly for low-income families (Capizzano et al., 2002). During the summer months, of children in care, only one third attend center care or formal programs with the other two thirds in home-based care (Capizzano et al., 2002; Capizzano et al., 2000). Given parents' concerns about the supply of quality care and the large proportion of children who experience summer care, surprisingly little research examines summer child care arrangements for young school-age children and its relationship to child well-being.

The present study aims to address these gaps in the literature by examining the relationship between summer child care experiences and child academic achievement for young school-age children. Using a nationally representative sample of kindergartners, the Early Childhood Longitudinal Study Kindergarten cohort (ECLS-K), this study examines the relationship between formal center child care during the summer prior to first grade and both reading and math achievement assessed in the fall of first grade. I also investigate whether this relationship differed for children from economically disadvantaged households.

Background

How children spend their time out of school plays an important role in their development. Transactional and bioecological developmental theories posit that child development is the product of the interaction of the child with multiple contexts including home, school, and child care (Bronfenbrenner & Ceci, 1994; Sameroff, 1994). Prior to school entry, family and child care play an important role in children's development. As children move into school, their worlds broaden to include schools, peers, teachers, and other activities along with families and possibly child care. Theory suggests that these contexts should be influential in shaping children's development and developmental trajectories (Bronfenbrenner & Morris, 1998).

The importance of out of home contexts in early childhood for child development has received much attention from researchers. A large literature has examined the relationship between child care prior to school entry and child achievement or cognitive development (Magnuson et al. 2004; NICHD ECCRN 2000, 2002, 2004; Shonkoff & Phillips, 2000). These

studies consistently find a positive relationship between formal center child care and child achievement, particularly for children from disadvantaged backgrounds (Magnuson et al., 2004; Shonkoff & Phillips, 2000). Similarly, model early childhood intervention programs like Perry Preschool or the Carolina Abecedarian Program that targeted low-income children or children with low levels of skills have been shown to promote children's short run cognitive skills (Barnett, 1995; Campbell, Ramey, Pungello, Sparling, and Miller-Johnson, 2002). These studies suggest that across socioeconomic status (SES) early center care is important for child achievement, but that it is most important for those from more disadvantaged homes.

For school-age children, research has shown that children's experiences outside of home and school during the school year are important for their development (Mahoney, Larson, & Eccles, 2005; Posner & Vandell, 1994; 1999). Formal after-school programs (Posner & Vandell, 1994, 1999; Riley, Steinberg, Todd, Junge, & McClain, 1994) and structured after-school activities, including clubs, sports, and other programs (Morris & Kalil, 2006; Ripke, Huston, & Casey, 2006) appear promote academic achievement and positive behavior, particularly among low-income children. Formal and structured programs provide children with safe environments and adult supervision. While this research is informative for thinking about school-year experiences for all children in middle childhood, the comparison groups in these studies are typically children in self-care or hanging out with peers. Between the ages of 6-9, children continue to participate in non-parental child care, and there are few studies of how these more typical child care experiences relate to child outcomes.

Patterns of school-age child care use vary by child age and family income (Capizzano et al., 2000; Smith, 2000). Not surprisingly, younger school-age children experience more non-parental child care arrangements, while older children are often unsupervised or in formal before- and after-school programs. In addition, higher income families use more formal center care for their school-age children, while low-income families utilize informal care (Capizzano et al., 2000). In the summer months, young school-age children (ages 6-9) of all backgrounds experience a substantial amount of informal care—significantly more relative care than during the school year (Capizzano et al., 2002). Parents report that finding and securing child care for this long break can be challenging (Duffet et al, 2004), and low-income families report that the cost and supply of formal center care is often out of reach. If formal out of school activities promote academic skills, and formal child care prior to school also promotes academic skills, it is likely that formal summer child care could promote child achievement. However, few studies have examined the role of child care during the summer months in child development.

It should be noted that the limited research on school-age child care during the summer months is likely due to data availability. Most large-scale longitudinal studies do not collect detailed information about children's summer child care arrangements, focusing on school-year activities. The National Survey of American Families (NSAF) is one of the only sources of nationally representative information about summer child care activities for school-age children. However, given the importance of out of home and school contexts for child development, more data should be collected about how children spend their summers. This could help to better understand differences in children's skills at the start of the school year.

Summer Break

A large literature documents the relationship between summer break and academic achievement loss (Alexander et al., 2007; Cooper et al., 1996). Children learn at slower rates

over the summer months or even lose ground, and this is particularly pronounced for low-income children (Alexander et al., 2007; Downey et al., 2004). The summer learning loss is typically explained by the quality and quantity of inputs children receive during the summer. Higher income families are likely to provide more cognitive stimulating environments for their children in the summer both at home and outside of the home.

The main areas of research in the summer learning loss literature focus on summer school, extended school years, and year-round schools. Most studies of summer school programs show that they have a positive effect on achievement (Cooper et al. 2000), but children who attend summer school are typically low achievers so it is not clear that summer school would boost achievement for all children. For example, summer school is often mandated or required of children who are not promoted to the next grade at the end of the school year, and the best evidence suggests that older students benefit from the program (Roderick et al., 2000). There is limited evidence on both extended school years and year-round school. These programs have been difficult to evaluate. For example, many Asian countries have longer school years than the 180-day US calendar and Asian children typically score higher in mathematics, but Asian countries also differ from the US in a variety of ways. In terms of year-round school, 40% of year-round schools in the US were created to alleviate over-crowding, not specifically to promote achievement. However, there is some evidence to suggest that re-arranging the school year into year-round school does eliminate the summer learning loss, but does increase overall achievement (von Hippel, 2007).

In sum, the prior literature has found clear and consistent evidence of slowed learning in the summer, particularly for disadvantaged students, suggesting that how children spend their summer is likely to influence their development. A substantial proportion of young school-age children spend their time in non-parental child care during the summer months and formal child care programs prior to school entry and formal programming during the school year appear to promote academic skills for all students. Taken together, this suggests that child care experiences during the summer are likely to influence child achievement, and might be particularly important for low-income children.

Present Study

The present study examines the relationship between formal center child care during the summer prior to first grade and child achievement in the fall of first grade. First, a description, using a nationally representative sample, of the extent and type of children's summer child care experiences is provided, focusing on the differences by family income. Then, how these experiences relate to reading and math achievement in the fall first grade is examined. Finally, I examine how any relationship between formal summer child care and child achievement might vary by family background including family income, poverty status, family structure, child sex, and maternal education. It is expected that attending formal center child care will be related to higher achievement test scores for children in the fall of first grade. In addition, for low income children, the direction of this relationship is less clear. While center care should be expected to promote achievement skills among low income children, the school-age center care available to low-income families might be of poor quality, resulting in a neutral or potentially a negative relationship.

Method

Data

Data for this study came from the ECLS-K. The ECLS-K is a nationally representative sample of over 21,000 children who entered kindergarten during the 1998-99 school year. The study included children in public and private schools as well as children in full- and part-day kindergarten programs. Given that these data are nationally representative, the sampled children are diverse in terms of their race/ethnicity and income. Data was collected from parents, teachers, school administrators, and direct assessments of children. Thus, the ECLS-K contains extensive information on the child's home and school environments and experiences. Information about children's achievement came from tests of both reading and math skills. The ECLS-K was designed so that researchers could better understand how children's early experiences influence their subsequent school and developmental outcomes. This study relied on data collected in the fall and spring of kindergarten and the fall of first grade.

Sample

While the baseline sample included over 21,000 children, this analysis uses the 4,335 children included in the fall of first grade sub-sample with available summer child care information and not in year-round schools. The ECLS-K attempted to follow-up with all children at the spring of each grade. However, in the fall of first grade, one third of schools were randomly sampled for a follow-up, resulting in a sample of 27% of the eligible children. When weighted, the fall of first grade sub-sample is representative of the larger nationally representative sample of kindergartners. In addition, the ECLS-K provides weights to adjust for attrition and sampling design. The weighted and unweighted results of this study are virtually identical. Table 1 presents the descriptive statistics for the full analytic sample. As shown in Table 1, 60% of the sample is white, 14% black, and 15% Hispanic. Almost 20% of the sample resides in a single parent household, and 20% are at or below the poverty line. Almost half of the sample (44%) has non-parental child care in the summer, and 11% attend formal center child care.

Measures

Type of child care. The primary independent variables of interest were constructed using fall of first grade parent reports. In the fall of first grade, parents were asked about their child's regular weekly child care arrangements during the summer. Parents were asked these questions about three different types of care—center, non-relative, and relative care. From this information, two dichotomous variables were created one for formal center child care and one for home-based child care, pooling relative and non-relative care. Parents were also asked about the number of weekly hours of care and number of weeks of care. These duration variables are included in some specifications.

Child outcomes. The outcomes of interest are children's reading and math achievement test scores in the fall of first grade. The ECLS-K directly assessed child academic achievement skills at each wave of data collection. The tests were designed to measure the typical and important cognitive goals of elementary schools (National Center for Education Statistics [NCES], 2003). The tests included three domains: language and literacy (reading), mathematics,

and general knowledge. This study focuses only on the reading and mathematics assessments.¹ The test was designed to accurately measure children's skills across the entire span of the study.

The ECLS-K reading and math tests were designed to assess individual children using test items that are appropriate for each child's ability. Adaptive tests are efficient (Lord, 1980) and minimize floor and ceiling effects. The ECLS-K designed adaptive tests using Item Response Theory (IRT). IRT allows for all sampled children to be rated using the same scale over time even though students receive different test items depending on their abilities. In addition, IRT tests given with computer assistance are on-time adaptive—the assessment adjusts the difficulty of the questions based on the real-time performance of the child (NCES, 2003). Thus, the assessments have small time costs to the tester and the student, and they are well calibrated to how the child is actually performing in a given domain.

Reading test. The ECLS-K reading test was developed based on the National Assessment of Educational Progress (NAEP) 1992 and 1994 reading framework. The reading assessment content included: initial understanding; developing interpretation; personal reflection and response; and demonstrating a critical stance (NCES, 2003). Items used in the ECLS-K reading test came directly from or were adapted from several published tests such as the Peabody Individual Achievement Test (PIAT), Peabody Picture Vocabulary Test (PPVT), Primary Test of Cognitive Skills (PTCS), Test of Early Reading Ability (TERA), and Woodcock-Johnson Tests of Achievement (WJ-R). The ECLS-K reading test has a reported test-retest reliability of .95. The reading test measured children's basic skills, vocabulary, and comprehension. The test contained five proficiency levels including identifying letters, associating letters with sounds at the beginning and end of words, recognizing words by sight, and reading words in context.

Mathematics test. The ECLS-K math test was developed based on the NAEP 1996 mathematics framework and the National Council of Teachers of Mathematics (NCTM) content standards. The mathematics test content included: number sense, properties and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions (NCES, 2003). The first domain, number sense, properties and operations, was the primary emphasis of the early elementary school assessments. Items used in the ECLS-K math test come directly from or were adapted from several published tests such as the PIAT-R, PTCS, Test of Early Mathematics Ability (TEMA), and WJ-R. The ECLS-K mathematics test has a reported test-retest reliability of .94. The math assessment measured children's conceptual and procedural knowledge and problem solving skills. The assessment consisted of five proficiency levels including identifying numerals, counting, patterns, ordinality, solving word problems, addition, subtraction, multiplication, and division.

Covariates. Given that parents' selection of child care is related to both parental and child characteristics (Fuller et al., 1996; Singer et al., 1998), including extensive family and child demographic and background characteristics as controls is important. A wide range of variables that have been shown to relate to achievement and/or selection of child care. Descriptive statistics for these variables are shown in both Table 1 and Appendix A. Child background characteristics include age, sex, race/ethnicity, and overall health. Home environment characteristics include number of siblings, household composition, mother's age at child's birth,

¹ The General Knowledge Test covers a wide-range of content, and from available documentation, it is not clear what this measure is assessing. In other studies using the ECLS-K, this test is used as a measure of general cognitive abilities, and in this study the fall of kindergarten measure of general knowledge is used as a control variable.

whether or not the mother worked between child’s birth and kindergarten, mother’s current work status, four or more moves prior to kindergarten, and number of books in the home. Covariates also include whether or not the child attended summer school, camp, or other activities. Parents reported on how often they engaged in academic activities with their child such as reading, writing, and math, and parents reported how often they went to the museum, library, and other activities.

Analytic Strategy

The primary relationship of interest, between type of summer child care and fall of first grade child achievement, takes the form:

$$(1) \quad \mathbf{ACH}_{iF1} = \mathbf{a}_1 + \beta_1 \mathbf{Center}_{iSUM} + \beta_2 \mathbf{Activities}_{iSUM} + \beta_3 \mathbf{ACH}_{iSK} + \beta_4 \mathbf{ACH}_{iFK} + \beta_5 \mathbf{Child}_{iFK} + \beta_6 \mathbf{Fam}_{iFK} + \epsilon_{iF1}$$

Where \mathbf{ACH}_{iF1} is the fall of first grade (F1) reading or math achievement test score of child i . \mathbf{Center}_{iSUM} is a dichotomous measure of whether or not child i attended center child care during the summer prior to first grade. Children who not in center care during the summer serve as the reference group. $\mathbf{Activities}_{iSUM}$ is a vector capturing the other summer activities a child participated in, including summer school, summer camp, and tutoring. \mathbf{ACH}_{iSK} and \mathbf{ACH}_{iFK} are the spring and fall of kindergarten reading and math achievement test scores for child i . Both scores are included here to capture an achievement trend rather than one point in time. This model also includes \mathbf{Child}_{iFK} and \mathbf{Fam}_{iFK} , background and demographic characteristics of both the child and the family measured in fall of kindergarten. This includes the kindergarten measures of the child’s attention-related skills. In addition, given the nature of the data, this model includes school fixed effects. Comparisons are made between children who attended the same school in both kindergarten and first grade. This holds constant the length of summer, some neighborhood characteristics, and it also adjusts for school inputs.²

The second relationship of interest, between extent of child care during the summer child achievement, takes the form:

$$(2) \quad \mathbf{ACH}_{iF1} = \mathbf{a}_1 + \beta_1 \mathbf{Center}_{iSUM} + \beta_2 \mathbf{Totalhours}_{iSUM} + \beta_3 \mathbf{Activities}_{iSUM} + \beta_4 \mathbf{ACH}_{iSK} + \beta_5 \mathbf{ACH}_{iFK} + \beta_6 \mathbf{Child}_{iFK} + \beta_6 \mathbf{Fam}_{iFK} + \epsilon_{iS1}$$

Where $\mathbf{Totalhours}_{iSUM}$ is the amount of time a child spends in center child care over the course of the summer. This captures the cumulative number of hours a child spends in center care between kindergarten and first grade. All other components are identical to those in equation (1).

In addition to these two specifications, I also examine hours per week and number of weeks of care rather than the cumulative total hours measure. I also investigate any differences for subgroups of children by family income.

Because children were not randomly assigned to summer child care, both observed and unobserved characteristics of the child and family could bias the estimates of the coefficients of interest. Baseline \mathbf{Child}_{iFK} and \mathbf{Fam}_{iFK} variables were included to address these concerns. Capitalizing on the longitudinal nature of the data, each model controlled for the spring and fall of kindergarten measure of the outcomes of interest. Sometimes referred to as a “lagged-y” or

² Children were not given tests on the very first day of the fall of first grade, thus, they all received some school input prior to the test.

“residual change” model, inclusion of this measure of the outcome of interest reduces potential omitted variable bias as there are likely unobserved characteristics of the child that are related to both the kindergarten and the fall of first grade measures of socioemotional well-being (Votruba-Drzal et. al, 2004).

In addition, due to the focus on summer experiences, this study uses school fixed effects models holding constant the length of summer in the analysis. School fixed effects also help to account for some neighborhood characteristics as well as other school specific inputs. Finally, because those children in child care might be systematically different from those not in child care, I re-run all the above specifications for only the sample that experiences any child care in the summer prior to first grade (n=1967).

Results

Tables 1, 2, and 3 present descriptive statistics for the full analytic sample, and broken down by type of summer child care (Table 2), and by quintile of the income distribution (Table 3). As shown in Table 1, just under half (44%) of the sample experiences non-parental child care during the summer prior to first grade. About one third of these children attend formal center care, and the other two thirds attend home-based arrangements.

Turning to Table 2, Children in center care, spend an average of 35 hours per week of care for an average of 9 weeks, and children in home-based care, average 30 hours per week for 8.5 weeks. In terms of other summer activities, children in child care participate in summer camp and school at about equal rates, but about one quarter of children in no non-parental care participate in camps. Children in center care and no care visit museums, parks, and beaches, while children in home-based care take fewer trips to the museum.

Also shown in Table 2, children in any child care are more likely to live in a single parent household than children not in child care in the summer. These children are also more likely than those not in care to have a mother who currently works full- or part time. In terms of prior child care experiences, children in care during the summer were more likely to participate in care during both the kindergarten and preschool years compared to those not in care.

Table 3 shows the characteristics of the sample broken down by quintile of the income distribution. The median income for each quintile is \$11,000, \$25,000, \$50,000, \$72,000, and \$90,000. As shown in Table 3, the rates of participation in summer child care are slightly higher in the bottom two income quintiles, although these differences are not statistically significant. Across the income groups, the one third, two thirds split between center and home-based child care remains. Not unexpectedly, children in the highest income quintile visit more museums and parks than their lower-income counterparts. Table 3 also shows the income gradient in maternal education with more mothers in the higher income quintiles having more education.

Together, these descriptive tables show that summer child care participation is fairly evenly distributed across household income groups, and almost half of all children participate in regular summer non-parental child care arrangements. These descriptive results also suggest that families utilizing non-parental care in the summer months are likely to be doing so to support work schedules as evidenced by the rates of maternal employment for children in child care. In addition, although summer camps are regularly utilized by all families, these programs are used for much short duration across all children (in child care and not, and by income) in both hours per week and weeks of the summer. The median number of weeks in camp for those children in

camp is three compared to a median of 10 weeks of child care for those children in care (not shown).

Figures 1-4 plot the unadjusted mean reading and math achievement test scores in the fall and spring of kindergarten and the fall of first grade. Figure 1 shows that children across summer child care status have steep gains in reading during the school year, and flatter gains during the summer. All of the lines in this figure have similar slopes, and although children in center care and children with no care appear to have higher average scores, none of these differences are statistically significant. Figure 2 plots these unadjusted means for math achievement by summer child care, showing that children's math gains slow in the summer. Figures 3 and 4 show reading and math scores by quintile of the income distribution. Again, showing a flattening of the slope during the summer months across all income groups and for both reading and math.

Center child care and reading and math achievement. Table 4 shows the results from school fixed effect regression models for the full analytic sample predicting the fall of first grade reading or math achievement with summer child care participation. All outcomes are standardized to the full weighted sample, so coefficients can be interpreted in standard deviation units. The first four columns of Table 4 show the results for fall of first grade reading achievement and the last four columns for math achievement. Columns (1) and (5) include a dummy variable for center child care during the summer, controls for other summer activities, and school fixed effects. Columns (2) and (6) add the measures of kindergarten achievement to the first model, the third column for each outcome adds the full set of control variables shown in Appendix A and Table 1, and columns (4) and (8) add controls for preschool and kindergarten child care experiences.

Focusing on reading outcomes in Table 4, columns (1) through (4) show a small relationship between center care and fall of first grade reading achievement. Columns (3) and (4) which include all the control variables show that children who attend center child care during the summer score .05 of a standard deviation higher in reading achievement at the fall of first grade than those children who had no center care during the summer. Turning to math achievement shown in columns (5) through (8), the results show no statistically significant relationship between center child care during the summer and fall of first grade math achievement. Even though the coefficients on center child care are not statistically significant, the magnitude of the coefficient is quite similar to the coefficient in the reading achievement models—about .05 of a standard deviation.

Table 5 adds measures of the number of hours children experience center child care during the summer months to the models shown in Table 4. The models in Table 5 examine if there is any relationship between the amount of summer child care and child achievement in the fall of first grade. Again the first eight columns present the results for reading achievement and the second set of columns for math achievement. Focusing first on reading achievement, the results shown in Table 5 show that there is no relationship between cumulative hours of center care and reading achievement (Table 5, column 2) once the full range of child and family background characteristics are included. The coefficient on center child care remains positive, although only marginally significant ($p < .1$). This indicates that even net of hours of center care, children who attend center care have higher reading achievement in the fall of first grade. For math achievement, there are no statistically significant relationships in Table 5. Suggesting that once hours of center care are accounted for, there is no difference in fall of first grade math

achievement between children in center care and those in home-based care or no non-parental care.

Table 5 also breaks out hours per week and number of weeks of care, and again, there is no relationship between extent of center care in the summer and child reading or math achievement. Columns (4), (8), (12) and (16) examine any potential non-linear relationship between hours of summer care and child achievement, showing no non-linearities.

Are there differences by family income? Table 6 presents the results of school fixed effects regression models predicting reading achievement with attending center child care during the summer with and without controlling for hours of care. Children who attended center child care during the summer from the second and fifth income quintiles have higher reading achievement test scores in the fall of first grade compared to their counterparts in home settings. These coefficients suggest that children in these income groups score between .15 and .2 of a standard deviation higher in reading. For the other income groups, the results are statistically insignificant, and in the case of the bottom and the middle quintiles, negative in magnitude, suggesting that children in center care might perform worse than their peers not in center care. This pattern of results holds even controlling for hours of center care.

Table 7 presents the results by income quintile for math achievement outcomes. Again, there are few statistically significant relationships between center child care and math achievement in the fall of first grade. Interestingly, almost all of the coefficients on center child care for all income groups are positive, although not statistically significant. For the middle income quintile, children who attend center care appear to have higher math scores than their peers not in center care, although this coefficient is not consistently statistically significant and doubles in size once hours are included in the model.

Are there differences by other child and family characteristics? Table 8 shows the results of models using center child care in the summer to predict reading achievement in the fall of first grade for key subgroups of children, including those in poverty, single parent households, children whose mothers have low education (less than high school diploma), and for boys and girls. Caution should be used in interpreting the results for the subgroups (excluding gender) as sample sizes and prevalence of center child care use are small. Interestingly to note, for poor children and children with single parents, the point estimates for center child care are negative, although not statistically significant.

Table 9 presents the results for these same subgroups of children for math achievement outcomes. As with the full sample, center care in the summer continues to have little relationship with fall of first grade math achievement. However, unlike reading achievement, the coefficients for center child care are always positive in magnitude, although not significant.

Center child care versus home-based child care. One concern with the results presented thus far is that children who attend child care during the summer are systematically different from those who do not. I ran all the above model specifications on only the sample of children in non-parental child care during the summer. This excludes all children in no non-parental care (more than half the sample) from the analysis. Again, this reduces the sample sizes for the subgroup analyses substantially, so little can be made of differences for these children. However, as shown in Table 10, among children in care, attending center child care is related to higher reading achievement test scores in the fall of first grade, .05-.1 of a standard deviation.

For math achievement outcomes, the pattern of results is similar, although the point estimates are smaller.

Tables 11 and 12 present the results for reading and math achievement by child and family background characteristics for only the sample of children in non-parental child care during the summer. As shown in these tables, there are few statistically significant coefficients on center child care during the summer. However, for the second and fifth income quintiles, children who attend center care appear to have higher reading achievement test scores in the fall of first grade than children with similar incomes in home-based child care. Surprisingly, poor children who attend center care actually score much worse in terms of reading achievement than their peers in home-based care, but again, this is based on a very few poor children in center child care.

Discussion

Using a nationally representative sample of kindergarteners, this study provides suggestive evidence of the relationship between summer child care prior to first grade and children's reading and math achievement at the start of first grade. The results confirm that children's child care experiences during the summer months prior to first grade are related to their achievement at the beginning of the first grade. The results suggest that on the average children in formal center child care have higher reading test scores than their peers not in center care. There is suggestive evidence that children in center care also have higher math scores, although this was not consistently statistically significant. This relationship between center care and reading achievement was sustained with controls for child and family background characteristics, school fixed effects, and prior child achievement and child care experiences. In addition, among only those children in child care during the summer months, attending center care was related to higher reading achievement compared to children in informal home-based settings, although only at a marginal level of statistical significance. Differences in the relationship between center child care and achievement for subgroups of children were less consistent, although children from the second and fifth income quintiles appeared to benefit most from center care during the summer.

The results of this study show that children's summer experiences likely matter for their academic achievement, and that formal child care might promote skills. Consistent with prior studies focused on formal or structured out of school activities (Posner & Vandell, 1994, 1999; Ripke et al., 2006), this study found that out of home and out of school experiences are potentially important for children's academic achievement. Children who attended center care during the summer months scored about .05 of a standard deviation higher on a test of reading achievement at the fall of first grade, holding constant a range of child and family background characteristics and controlling for prior achievement. This suggests that center care likely provides more cognitive stimulation and perhaps focused attention on reading skills than other less formal experiences.

The results for math achievement outcomes were less consistent, although they tended to suggest some positive relationship between center care and math skills. This is actually not surprising as some education literature has found that the summer is more detrimental to children's mathematics achievement (Cooper et al, 1996), and that reading skills can be learned

at both home and school (Bryk & Raudenbush, 1988; Entwisle & Alexander, 1995), but math is primarily learned at school.

Given that summer learning loss has been an important topic of education research for some time, it is important to note that in the sample used here all children gain skills across the summer, some gain more than the others. The results here suggest that center care during the summer benefits children in the top quintile of the income distribution about a fifth of a standard deviation compared to their counterparts not in center care. This is likely due to the quality of the programming that families in this income groups can purchase for their children. Children from higher income families have access to better and more stimulating child care experiences at all periods of childhood than families with lower incomes. Children from the lowest income quintile did not see the same benefits from center child care during the summer, but those in the second income quintile group did. Again, this suggests something about the quality of available programming for these families or that any formal care, regardless of quality, is better for these children's reading skills. Families in the lowest quintile have a median income of \$11,000, while families in the second quintile have a median income of \$25,000. These families with slightly higher incomes could be able to choose from a wider range of quality child care programming. This suggests that lower-income children might benefit from higher quality, cognitively stimulating summer experiences, and it might help eliminate some of the lower gains in achievement over the summer for these children. However, it might also mean that for this income group, home and home-based care environments are particularly poor at promoting reading skills, and any exposure to center care is positive for these children.

An important question for this study is whether or not the observed relationship between center child care and academic achievement is causal. Parents who choose different types of summer care arrangements for their children might be different in other ways. These parents might be more motivated to find stimulating environments for their children or better equipped to do so. Parents might be better at navigating the red tape of child care programs, including signing up and getting on waiting lists so as to secure their child a slot. Having these skills as a parent might also influence other factors correlated with achievement or be directly related to the child's achievement.

Family background characteristics and characteristics of children have been shown to be related to both child care use and type of care (Fuller et al, 1996; Singer et al., 1998). It is also likely that the cost and supply of child care are important factors in using care. Families with access to a wide range of options might be able to choose better programs for their children than those with fewer choices. Alternatively, families with a lot of options might not be able to best identify the highest quality programs. Even more importantly, family factors such as work, income, number of other children are likely to influence parents' use of care and also be correlated with child achievement.

To address some of these concerns, this study used several techniques. First, as many family and child characteristics as possible were included as control variables. Characteristics of the child's home learning environment as well as information about other activities during the summer, family income, size, and structure as well as maternal education were accounted for in the analysis. However, it still could be that children in center child care have parents who provide more stimulating environments at home, and in the absence of center care, these children would still see achievement gains compared to their peers.

Second, this analysis also used a residualized change model to account for unobserved characteristics of the child and family that might be correlated with child care and the outcome of interest. Both the fall and spring of kindergarten test score measures were included in the analysis, and even net of these controls, the relationship between center care and child achievement persists. Third, the analysis relies on school fixed effects in order to account for the length of the summer and to account for characteristics of schools and neighborhoods that might influence choice of child care and child achievement. Finally, children in child care during the summer might be systematically different from those children not in child care. Yet, specifications using only the sample of children in child care produced results consistent with those from the full sample. This suggests that center care might still be important for achievement, but it does not give the causal estimate of the effect of summer center care and child achievement.

Other limitations of this study should be noted. The available data do not allow for an examination of the quality of the child care experiences during the summer. This is important to note since other studies have shown that quality is an important factor in the relationship between child care and child outcomes (NICHD & Duncan, 2003; Votruba-Dzal et al., 2004). This study also focused on the summer between kindergarten and first grade, but the relationship between center care and child achievement might be different for slightly older children (7-9 years), but the data does not allow for that analysis. The children in this study just completed their first year of formal schooling, and almost half of them attended part-day kindergarten. Thus, making the change in school to summer experiences different for these children compared to older children who might have more routines and activities to change with the onset of summer.

In sum, this analysis provides some suggestive evidence that attending center child care prior to first grade provides some benefits for children's reading achievement. These benefits are more for children in the highest and lower- (but not the lowest) income families. There was no evidence that the amount of time children spent in center care was related to child reading or math achievement. The size of the effect of center care varies for different children. On average, it was about .05 of a standard deviation for reading—practically speaking quite small. However, for children in the lower income quintile and highest, the effect was much larger, closer to .2 of a standard deviation. For these groups of children, this effect is large enough to be considered important for child development.

Would these children have higher skills at the fall of first grade absent center care? This study is limited in its ability to answer that question. Given that over half of all young children participate in child care during the summer months, but that only one third attend formal center care, the results found here suggest that improving parents' ability to access and afford center care could help eliminate some of the overall slow gains in learning during the summer, but could help some groups of children more. This study points to summer child care as an important avenue to help to promote early achievement skills which provide an important foundation for later school success.

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| Table 1. Descriptive Statistics for Analytic Sample | | | | |
|--|-------------|------------------|------------|------------|
| | Mean | Std. Dev. | Min | Max |
| Reading Achievement Test Scores | | | | |
| Fall of Kindergarten | 23.86 | 9.27 | 10.50 | 81.26 |
| Spring of Kindergarten | 34.16 | 11.43 | 12.01 | 85.01 |
| Fall of First Grade | 39.32 | 12.96 | 12.57 | 86.63 |
| Math Achievement Test Scores | | | | |
| Fall of Kindergarten | 20.20 | 7.47 | 7.06 | 56.91 |
| Spring of Kindergarten | 28.34 | 8.95 | 8.34 | 59.75 |
| Fall of First Grade | 33.29 | 9.49 | 8.10 | 60.03 |
| Length of summer in weeks | 11.20 | 1.49 | 6.14 | 16.00 |
| Summer Child Care | | | | |
| Any summer child care | 0.44 | 0.49 | 0.00 | 1.00 |
| Center care | 0.11 | 0.32 | 0.00 | 1.00 |
| Home-based care | 0.31 | 0.46 | 0.00 | 1.00 |
| Hours/week center child care | 3.94 | 12.93 | 0.00 | 135.00 |
| Weeks of center care | 1.01 | 2.98 | 0.00 | 16.00 |
| Total hours of center child care | 39.98 | 143.54 | 0.00 | 1420.00 |
| Hour/week home-based care | 9.08 | 16.99 | 0.00 | 140.00 |
| Weeks of home-based care | 2.60 | 4.22 | 0.00 | 16.00 |
| Total hours of home-based care | 79.38 | 157.72 | 0.00 | 1416.00 |
| Other Summer Activities | | | | |
| Length of vacation in weeks | 1.31 | 1.50 | 0.00 | 17.14 |
| Attends camp | 0.22 | 0.42 | 0.00 | 1.00 |
| Hours/wk camp | 6.59 | 15.37 | 0.00 | 168.00 |
| Weeks of camp | 0.89 | 2.25 | 0.00 | 15.00 |
| Total hours of camp | 27.00 | 77.66 | 0.00 | 840.00 |
| Attends summer school | 0.11 | 0.31 | 0.00 | 1.00 |
| Hours/wk summer school | 2.37 | 7.45 | 0.00 | 40.00 |
| During the summer, do you visit the following: | | | | |
| Art or Science Museum | 0.41 | 0.49 | 0.00 | 1.00 |
| History Museum | 0.43 | 0.49 | 0.00 | 1.00 |
| Zoo | 0.63 | 0.48 | 0.00 | 1.00 |
| Amusement Park | 0.67 | 0.47 | 0.00 | 1.00 |
| Beach | 0.84 | 0.37 | 0.00 | 1.00 |
| Nature Park | 0.57 | 0.50 | 0.00 | 1.00 |
| During the summer: | | | | |
| Never does math with child | 0.19 | 0.39 | 0.00 | 1.00 |
| Never writes with child | 0.14 | 0.34 | 0.00 | 1.00 |
| Reads with child <2 times/week | 0.25 | 0.43 | 0.00 | 1.00 |

| Table 1. continued | | | | |
|--|---------|----------|---------|-----------|
| Baseline Child Characteristics | | | | |
| Race/ethnicity | | | | |
| White | 0.61 | 0.49 | 0.00 | 1.00 |
| Black | 0.14 | 0.35 | 0.00 | 1.00 |
| Hispanic | 0.15 | 0.36 | 0.00 | 1.00 |
| Asian | 0.06 | 0.23 | 0.00 | 1.00 |
| Other | 0.06 | 0.23 | 0.00 | 1.00 |
| | | | | |
| Child is female | 0.49 | 0.50 | 0.00 | 1.00 |
| Child age in months at kindergarten | 68.29 | 6.16 | 0.00 | 84.03 |
| Number of siblings | 1.28 | 1.17 | 0.00 | 9.00 |
| Single parent household | 0.18 | 0.38 | 0.00 | 1.00 |
| Primary home language not English | 0.11 | 0.31 | 0.00 | 1.00 |
| Mother currently works | 0.58 | 0.49 | 0.00 | 1.00 |
| Mother employed prior to K | 0.70 | 0.46 | 0.00 | 1.00 |
| | | | | |
| Maternal education | | | | |
| Less than HS diploma | 0.12 | 0.33 | 0.00 | 1.00 |
| HS diploma | 0.33 | 0.47 | 0.00 | 1.00 |
| Some College | 0.43 | 0.49 | 0.00 | 1.00 |
| Professional degree | 0.09 | 0.28 | 0.00 | 1.00 |
| At or below poverty | 0.19 | 0.39 | 0.00 | 1.00 |
| Household income | 5230.93 | 44119.15 | 2500.00 | 250000.00 |
| | | | | |
| Overall child health (1=excellent, 5=poor) | 1.45 | 0.94 | 0.00 | 5.00 |
| Number of children's books in the home | 67.59 | 61.76 | 0.00 | 200.00 |
| Preschool child care | 0.70 | 0.46 | 0.00 | 1.00 |
| Center care | 0.50 | 0.50 | 0.00 | 1.00 |
| Home-based care | 0.20 | 0.40 | 0.00 | 1.00 |
| Hours/wk care | 24.28 | 21.33 | 0.00 | 130.00 |
| | | | | |
| Kindergarten child care | 0.41 | 0.49 | 0.00 | 1.00 |
| Center care | 0.17 | 0.38 | 0.00 | 1.00 |
| Home-based care | 0.24 | 0.43 | 0.00 | 1.00 |
| Hours/wk care | 9.06 | 13.34 | 0.00 | 108.00 |
| n=4337 | | | | |

| Table 2. Descriptive Statistics by Summer Child Care | | | | |
|---|------------|--------------------|------------------------|----------------------|
| | | | | |
| Summer Child Care: | Any | Center Care | Home-Based Care | No Child Care |
| Reading Achievement Test Scores | | | | |
| Fall of Kindergarten | 23.23 | 23.82 | 23.08 | 24.38 |
| Spring of Kindergarten | 33.40 | 34.30 | 33.24 | 34.72 |
| Fall of First Grade | 38.55 | 39.40 | 38.28 | 39.90 |
| Math Achievement Test Scores | | | | |
| Fall of Kindergarten | 19.78 | 20.30 | 19.69 | 20.52 |
| Spring of Kindergarten | 28.02 | 28.54 | 27.94 | 28.58 |
| Fall of First Grade | 32.97 | 33.80 | 32.79 | 33.50 |
| Length of summer in weeks | 11.21 | 11.24 | 11.20 | 11.20 |
| Summer Child Care | | | | |
| Any summer child care | 1.00 | 1.00 | 1.00 | 0.00 |
| Center care | 0.28 | 1.00 | 0.00 | 0.00 |
| Home-based care | 0.71 | 0.00 | 1.00 | 0.00 |
| Hours/week center child care | 9.35 | 34.86 | 0.00 | 0.00 |
| Weeks of center care | 2.40 | 8.98 | 0.00 | 0.00 |
| Total hours of center child care | 94.98 | 355.38 | 0.00 | 0.00 |
| Hour/week home-based care | 21.59 | 0.00 | 29.81 | 0.00 |
| Weeks of home-based care | 6.18 | 0.00 | 8.53 | 0.00 |
| Total hours of home-based care | 188.60 | 0.00 | 260.50 | 0.00 |
| Other Summer Activities | | | | |
| Length of vacation in weeks | 1.17 | 1.13 | 1.18 | 1.42 |
| Attends camp | 0.18 | 0.17 | 0.19 | 0.26 |
| Hours/wk camp | 5.44 | 4.84 | 5.69 | 7.40 |
| Weeks of camp | 21.29 | 0.60 | 0.72 | 1.04 |
| Total hours of camp | 20.4 | 18.96 | 21.15 | 31.47 |
| Attends summer school | 0.11 | 0.11 | 0.10 | 0.11 |
| Hours/wk summer school | 11.97 | 12.98 | 10.82 | 11.78 |
| During the summer, do you visit the following: | | | | |
| | 0.39 | 0.45 | 0.37 | 0.43 |
| Art or Science Museum | 0.41 | 0.45 | 0.39 | 0.44 |
| History Museum | 0.64 | 0.70 | 0.62 | 0.62 |
| Zoo | 0.68 | 0.68 | 0.69 | 0.67 |
| Amusement Park | 0.84 | 0.85 | 0.83 | 0.84 |
| Beach | 0.55 | 0.59 | 0.54 | 0.58 |
| Nature Park | | | | |
| During the summer: | | | | |
| Never does math with child | 0.19 | 0.19 | 0.19 | 0.19 |
| Never writes with child | 0.12 | 0.13 | 0.11 | 0.15 |
| Reads with child <2 times/week | 0.26 | 0.23 | 0.27 | 0.23 |

| Table 2. | | | | |
|--|----------|----------|----------|----------|
| Baseline Child Characteristics | | | | |
| Race/ethnicity | 0.57 | 0.64 | 0.55 | 0.61 |
| White | 0.18 | 0.18 | 0.18 | 0.11 |
| Black | 0.13 | 0.09 | 0.15 | 0.16 |
| Hispanic | 0.05 | 0.03 | 0.06 | 0.06 |
| Asian | 0.06 | 0.06 | 0.07 | 0.05 |
| Other | | | | |
| Child is female | 0.50 | 0.52 | 0.49 | 0.49 |
| Child age in months at kindergarten | 68.26 | 68.14 | 68.32 | 68.31 |
| Number of siblings | 1.14 | 1.02 | 1.17 | 1.39 |
| Single parent household | 0.27 | 0.31 | 0.26 | 0.10 |
| Primary home language not English | 0.09 | 0.05 | 0.11 | 0.12 |
| Mother currently works | 0.73 | 0.77 | 0.73 | 0.46 |
| Mother employed prior to K | 0.81 | 0.83 | 0.81 | 0.60 |
| Maternal education | | | | |
| Less than HS diploma | 0.10 | 0.06 | 0.11 | 0.14 |
| HS diploma | 0.36 | 0.33 | 0.38 | 0.31 |
| College | 0.42 | 0.47 | 0.39 | 0.43 |
| Professional degree | 0.08 | 0.10 | 0.07 | 0.10 |
| At or below poverty | 0.20 | 0.17 | 0.20 | 0.19 |
| Household income | 50352.60 | 50277.78 | 50819.76 | 53698.81 |
| Overall child health (1=excellent, 5=poor) | 1.45 | 1.42 | 1.46 | 1.45 |
| Number of children's books in the home | 64.05 | 67.12 | 63.05 | 70.36 |
| Preschool child care | 0.76 | 0.80 | 0.75 | 0.65 |
| Center care | 0.46 | 0.62 | 0.40 | 0.54 |
| Home-based care | 0.30 | 0.17 | 0.35 | 0.12 |
| Hours/wk care | 32.20 | 33.78 | 31.70 | 18.11 |
| Kindergarten child care | 0.62 | 0.70 | 0.61 | 0.24 |
| Center care | 0.24 | 0.50 | 0.15 | 0.12 |
| Home-based care | 0.38 | 0.20 | 0.46 | 0.12 |
| Hours/wk care | 14.70 | 15.40 | 14.90 | 4.60 |
| n= | 1858 | 557 | 1226 | 2551 |

| Table 3. Descriptive Statistics by Household Income | | | | | |
|--|-------------------------|----------|----------|----------|------------|
| | Income Quintiles | | | | |
| | Bottom | | | | Top |
| | 1 | 2 | 3 | 4 | 5 |
| | Mean | | | | |
| Reading Achievement Test Scores | | | | | |
| Fall of Kindergarten | 19.25 | 21.57 | 23.79 | 25.09 | 27.94 |
| Spring of Kindergarten | 28.70 | 31.77 | 34.51 | 35.93 | 38.56 |
| Fall of First Grade | 32.78 | 36.59 | 39.88 | 41.52 | 44.53 |
| Math Achievement Test Scores | | | | | |
| Fall of Kindergarten | 15.83 | 18.23 | 20.23 | 21.86 | 23.96 |
| Spring of Kindergarten | 23.04 | 26.36 | 28.42 | 30.72 | 32.55 |
| Fall of First Grade | 27.75 | 31.10 | 33.26 | 35.76 | 38.03 |
| Length of summer in weeks | 11.11 | 11.15 | 11.25 | 11.27 | 11.20 |
| Summer Child Care | | | | | |
| Any summer child care | 0.46 | 0.45 | 0.40 | 0.43 | 0.40 |
| Center care | 0.12 | 0.12 | 0.10 | 0.10 | 0.11 |
| Home-based care | 0.33 | 0.32 | 0.29 | 0.32 | 0.27 |
| Hours/week center child care | 4.50 | 4.56 | 3.41 | 4.10 | 3.20 |
| Weeks of center care | 1.05 | 1.1 | 0.92 | 1.10 | 0.90 |
| Total hours of center child care | 45.60 | 47.16 | 34.12 | 40.45 | 34.29 |
| Hour/week home-based care | 10.30 | 9.37 | 8.92 | 7.99 | 7.83 |
| Weeks of home-based care | 2.70 | 2.70 | 2.65 | 2.28 | 2.26 |
| Total hours of home-based care | 81.31 | 81.20 | 80.06 | 70.50 | 67.37 |
| Other Summer Activities | | | | | |
| Length of vacation in weeks | 0.83 | 1.03 | 1.31 | 1.43 | 1.91 |
| Attends camp | 0.11 | 0.13 | 0.20 | 0.24 | 0.43 |
| Weeks camp | 0.51 | 0.59 | 0.84 | 1.35 | 2.88 |
| Hours/wk camp | 5.29 | 4.22 | 6.50 | 6.48 | 10.98 |
| Total hours of camp | 17.97 | 18.68 | 24.04 | 27.02 | 45.80 |
| Attends summer school | 0.13 | 0.11 | 0.10 | 0.10 | 0.11 |
| Hours/Week summer school | 14.24 | 12.91 | 9.84 | 9.49 | 11.95 |
| During the summer, do you visit the following: | | | | | |
| Art or Science Museum | 0.24 | 0.33 | 0.38 | 0.50 | 0.60 |
| History Museum | 0.27 | 0.36 | 0.45 | 0.50 | 0.55 |
| Zoo | 0.50 | 0.59 | 0.66 | 0.69 | 0.69 |
| Amusement Park | 0.59 | 0.66 | 0.68 | 0.71 | 0.74 |
| Beach | 0.73 | 0.80 | 0.85 | 0.88 | 0.92 |
| Nature Park | 0.48 | 0.55 | 0.58 | 0.62 | 0.62 |
| During the summer: | | | | | |
| Never does math with child | 0.18 | 0.17 | 0.20 | 0.21 | 0.22 |
| Never writes with child | 0.12 | 0.13 | 0.13 | 0.14 | 0.16 |
| Reads with child <2 times/week | 0.29 | 0.28 | 0.26 | 0.20 | 0.18 |

| Table 3. Continued. | | | | | |
|--|-------|-------|-------|-------|-------|
| Baseline Child Characteristics | | | | | |
| Race/ethnicity | | | | | |
| White | 0.33 | 0.48 | 0.65 | 0.75 | 0.77 |
| Black | 0.27 | 0.20 | 0.12 | 0.07 | 0.05 |
| Hispanic | 0.24 | 0.20 | 0.12 | 0.10 | 0.08 |
| Asian | 0.05 | 0.05 | 0.06 | 0.05 | 0.07 |
| Other | 0.11 | 0.07 | 0.04 | 0.03 | 0.02 |
| | | | | | |
| Child is female | 0.52 | 0.49 | 0.48 | 0.48 | 0.47 |
| Child age in months at kindergarten | 67.89 | 67.99 | 68.73 | 68.35 | 68.56 |
| Number of siblings | 1.35 | 1.28 | 1.24 | 1.23 | 1.27 |
| Single parent household | 0.40 | 0.23 | 0.13 | 0.07 | 0.05 |
| Primary home language not English | 0.21 | 0.16 | 0.08 | 0.05 | 0.05 |
| Mother currently works | 0.43 | 0.57 | 0.62 | 0.67 | 0.63 |
| Mother employed prior to K | 0.57 | 0.68 | 0.73 | 0.77 | 0.73 |
| | | | | | |
| Maternal education | | | | | |
| Less than HS diploma | 0.31 | 0.18 | 0.07 | 0.03 | 0.01 |
| HS diploma | 0.42 | 0.43 | 0.39 | 0.30 | 0.14 |
| College | 0.21 | 0.33 | 0.46 | 0.56 | 0.59 |
| Professional degree | 0.01 | 0.03 | 0.05 | 0.09 | 0.25 |
| At or below poverty | 0.68 | 0.25 | 0.04 | 0.01 | 0.00 |
| | | | | | |
| Overall child health | 1.59 | 1.56 | 1.41 | 1.34 | 1.30 |
| Number of children's books in the home | 35.87 | 52.14 | 72.62 | 83.36 | 95.08 |
| Preschool child care | 0.58 | 0.64 | 0.70 | 0.76 | 0.82 |
| Center care | 0.40 | 0.43 | 0.48 | 0.55 | 0.64 |
| Home-based care | 0.18 | 0.21 | 0.23 | 0.21 | 0.18 |
| Hours/wk care | 24.58 | 24.64 | 25.16 | 22.79 | 24.17 |
| | | | | | |
| Kindergarten child care | 0.35 | 0.39 | 0.42 | 0.45 | 0.44 |
| Center care | 0.11 | 0.15 | 0.15 | 0.21 | 0.23 |
| Home-based care | 0.24 | 0.24 | 0.26 | 0.23 | 0.20 |
| Hours/wk care | 9.73 | 8.96 | 9.29 | 8.67 | 8.60 |
| n= | 857 | 915 | 774 | 804 | 987 |

| Table 4. Fixed Effects Regressions Predicting Fall of First Grade Reading and Math Achievement using Summer Center Child Care | | | | | | | | |
|--|--------------------------------|------------------|--------------------|--------------------|-----------------------------|------------------|------------------|-------------------|
| | Reading Achievement Test Score | | | | Math Achievement Test Score | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Summer Child Care | | | | | | | | |
| Center Care | 0.043 (0.048) | 0.048 (0.041) | 0.053** (0.023) | 0.052** (0.025) | 0.052 (0.048) | 0.031 (0.042) | 0.039 (0.026) | 0.045* (0.027) |
| Other Summer Activities | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | | X | X | X | | X | X | X |
| Control Variables | | | X | X | | | X | X |
| Preschool and Kindergarten Child Care | | | | X | | | | X |
| Observations | 4366 | 4366 | 4366 | 4336 | 4499 | 4469 | 4469 | 4469 |
| R-squared | 0.385 | 0.850 | 0.854 | 0.862 | 0.427 | 0.810 | 0.827 | 0.827 |
| Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Tables 1 and Appendix A. | | | | | | | | |
| Models are weighted | | | | | | | | |
| *** p<0.01, ** p<0.05, *p<.1 | | | | | | | | |

Table 5. Fixed Effects Regressions Predicting Fall of First Grade Reading and Math Achievement using Summer Child Care and Hours of Summer Care

| | Reading Achievement Test Score | | | | | | | | Math Achievement Test Score | | | | | | | | |
|---|--------------------------------|-------------------|-----------------------|-------------------|----------------------|--------------------|---------------------|-------------------|-----------------------------|------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | |
| Summer Child Care | | | | | | | | | | | | | | | | | |
| Center Care | 0.179** (0.077) | 0.071* (0.038) | 0.263** (0.102) | 0.093* (0.049) | 0.263*** (0.093) | 0.105** (0.045) | 0.332*** (0.126) | 0.115* (0.061) | 0.094 (0.074) | 0.053 (0.042) | 0.165* (0.098) | 0.050 (0.055) | 0.102 (0.090) | 0.051 (0.051) | 0.133 (0.122) | 0.024 (0.068) | |
| Total hours of center care | -0.0004** (0.0002) | 0.000 (0.000) | -0.0009** (0.0004) | 0.000 (0.0002) | | | | | | | | | | | | | |
| Total hours of center care squared | | | 0.000 (0.000) | 0.000 (0.000) | | | | | 0.000 (0.000) | 0.000 (0.000) | -0.001 (0.000) | 0.000 (0.000) | | | | | |
| Hours/week center care | | | | | -0.006*** (0.002) | -0.002 (0.001) | -0.010 (0.001) | -0.002 (0.002) | | | 0.000 (0.000) | 0.000 (0.000) | -0.001 (0.002) | 0.000 (0.001) | -0.003 (0.001) | 0.001 (0.003) | |
| Hours/week center care squared | | | | | | | 0.000 (0.000) | 0.000 (0.000) | | | | | | | 0.000 (0.000) | 0.000 (0.000) | |
| Weeks of center care | | | | | 0.001 (0.017) | 0.003 (0.008) | 0.001 (0.017) | 0.003 (0.008) | | | | | | -0.012 (0.016) | 0.004 (0.009) | -0.012 (0.016) | 0.004 (0.009) |
| Other Summer Activities | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| School Fixed Effects | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| Fall & Spring of Kindergarten Achievement | | X | | X | | X | | X | | X | | X | | X | | X | |
| Control Variables | | X | | X | | X | | X | | X | | X | | X | | X | |
| Preschool and Kindergarten Child Care | | X | | X | | X | | X | | X | | X | | X | | X | |
| Observations | 4362 | 4335 | 4362 | 4335 | 4362 | 4335 | 4362 | 4335 | 4495 | 4466 | 4495 | 4466 | 4362 | 4335 | 4495 | 4466 | |
| R-squared | 0.386 | 0.862 | 0.387 | 0.862 | 0.386 | 0.862 | 0.387 | 0.862 | 0.428 | 0.828 | 0.428 | 0.828 | 0.386 | 0.862 | 0.428 | 0.828 | |

Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A.
 Models are weighted
 *** p<0.01, ** p<0.05, *p<.1

| Table 6. Fixed Effects Regressions Predicting Fall of First Grade Reading Achievement using Summer Center Child Care and Hours by Income | | | | | | | | | | |
|---|------------------------|--------------------|-------------------|------------------|---------------------|-------------------|-------------------|-------------------|------------------|---------------------|
| | Income Quintile | | | | | | | | | |
| | Bottom (1) | 2 | 3 | 4 | Top (5) | Bottom (1) | 2 | 3 | 4 | Top (5) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Summer Child Care | | | | | | | | | | |
| Center Care | -0.070 (0.062) | 0.166** (0.067) | -0.115 (0.084) | 0.025 (0.077) | 0.200*** (0.069) | -0.024 (0.073) | 0.147* (0.082) | -0.090 (0.098) | 0.069 (0.093) | 0.228*** (0.080) |
| Total hours of care | | | | | | X | X | X | X | X |
| Other Summer Activities | X | X | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | X | X | X | X | X | X | X | X | X | X |
| Control Variables | X | X | X | X | X | X | X | X | X | X |
| Preschool and Kindergarten Child Care | X | X | X | X | X | X | X | X | X | X |
| Observations | 794 | 873 | 767 | 803 | 988 | 794 | 873 | 767 | 803 | 988 |
| R-squared | 0.885 | 0.914 | 0.900 | 0.897 | 0.902 | 0.885 | 0.913 | 0.900 | 0.897 | 0.902 |
| Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A. | | | | | | | | | | |
| Models are weighted | | | | | | | | | | |
| *** p<0.01, ** p<0.05, *p<.1 | | | | | | | | | | |

| Table 7. Fixed Effects Regressions Predicting Fall of First Grade Math Achievement using Summer Child Care by Income | | | | | | | | | | |
|---|------------------------|------------------|------------------|------------------|------------------|-------------------|------------------|--------------------|------------------|------------------|
| | Income Quintile | | | | | | | | | |
| | Bottom (1) | 2 | 3 | 4 | Top (5) | Bottom (1) | 2 | 3 | 4 | Top (5) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Summer Child Care | | | | | | | | | | |
| Center Care | -0.002 (0.074) | 0.069 (0.078) | 0.107 (0.088) | 0.041 (0.090) | 0.050 (0.075) | -0.028 (0.086) | 0.021 (0.094) | 0.222** (0.102) | 0.153 (0.110) | 0.099 (0.087) |
| Total hours of care | | | | | | X | X | X | X | X |
| Other Summer Activities | X | X | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | X | X | X | X | X | X | X | X | X | X |
| Control Variables | X | X | X | X | X | X | X | X | X | X |
| Preschool and Kindergarten Child Care | X | X | X | X | X | X | X | X | X | X |
| Observations | 794 | 873 | 767 | 803 | 988 | 794 | 873 | 767 | 803 | 988 |
| R-squared | 0.885 | 0.914 | 0.900 | 0.897 | 0.902 | 0.885 | 0.913 | 0.900 | 0.897 | 0.902 |
| Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A. | | | | | | | | | | |
| Models are weighted | | | | | | | | | | |
| *** p<0.01, ** p<0.05 | | | | | | | | | | |

Table 8. Fixed Effects Regressions Predicting Fall of First Grade Reading Achievement using Summer Child Care by Child and Family Characteristics

| | Poor | Single Parent | Low Maternal Education | Girls | Boys | Poor | Single Parent | Low Maternal Education | Girls | Boys |
|---|---------------------|---------------------|------------------------|--------------------|----------------------|--------------------|---------------------|------------------------|--------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (11) |
| Summer Child Care | | | | | | | | | | |
| Center Care | -0.0853 (0.0651) | -0.0473 (0.0595) | 0.0570 (0.125) | 0.0245 (0.0371) | 0.0712** (0.0351) | -0.187 (0.0978) | -0.0586 (0.0908) | 0.149 (0.219) | 0.0559 (0.0577) | 0.0914* (0.0533) |
| Total hours of care | | | | | | X | X | X | X | X |
| Other Summer Activities | X | X | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | X | X | X | X | X | X | X | X | X | X |
| Control Variables | X | X | X | X | X | X | X | X | X | X |
| Preschool and Kindergarten Child Care | X | X | X | X | X | X | X | X | X | X |
| Observations | 769 | 755 | 428 | 2133 | 2205 | 769 | 755 | 428 | 2133 | 2205 |
| R-squared | 0.887 | 0.921 | 0.892 | 0.878 | 0.885 | 0.887 | 0.921 | 0.892 | 0.878 | 0.885 |

Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A .

Models are weighted

*** p<0.01, ** p<0.05, *p<.1

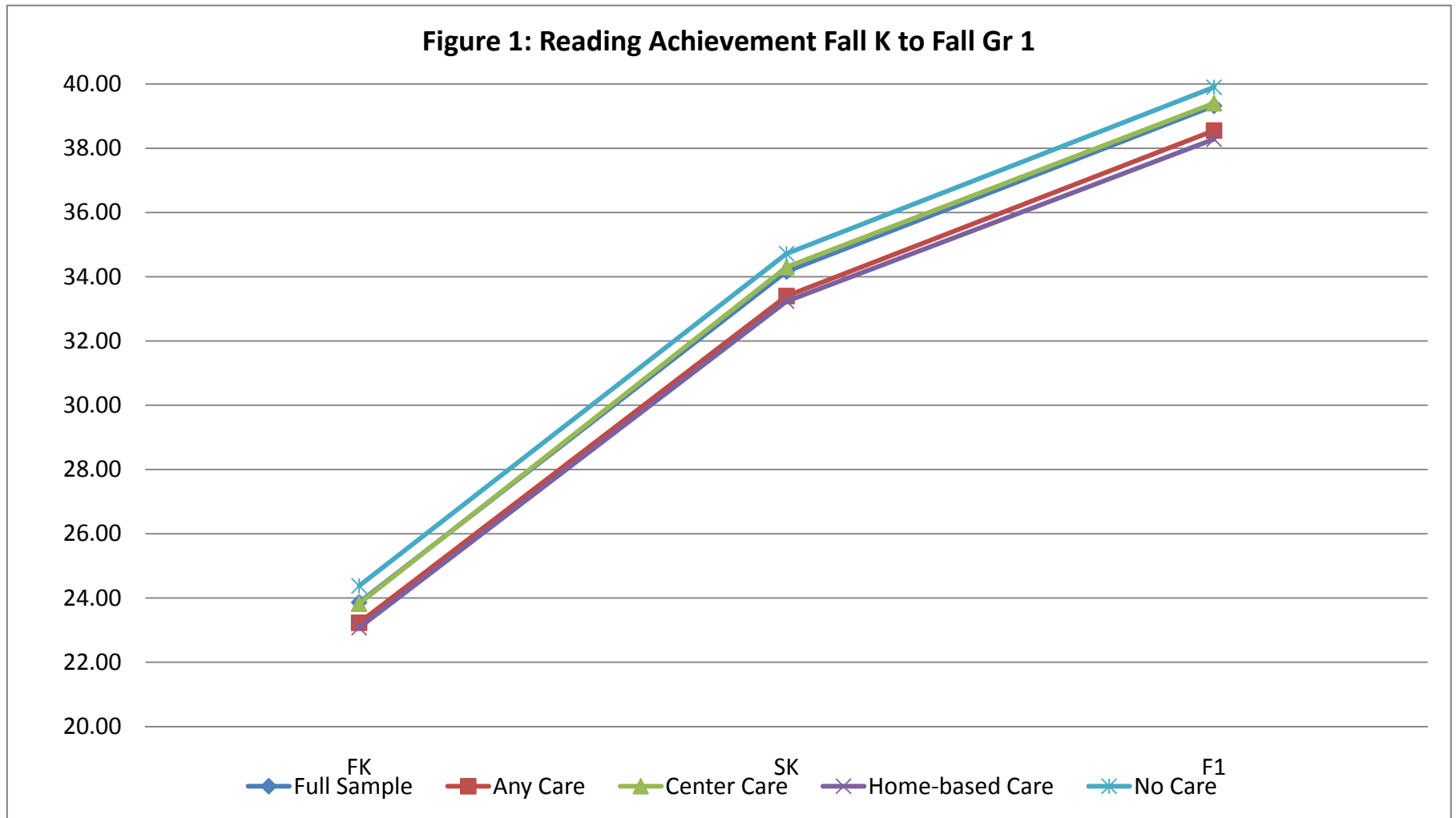
| Table 9. Fixed Effects Regressions Predicting Fall of First Grade Math Achievement using Summer Child Care by Child and Family Characteristics | | | | | | | | | | |
|---|--------------------|--------------------|------------------------|--------------------|--------------------|------------------|------------------|------------------------|--------------------|--------------------|
| | Poor | Single Parent | Low Maternal Education | Girls | Boys | Poor | Single Parent | Low Maternal Education | Girls | Boys |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Summer Child Care | | | | | | | | | | |
| Center Care | 0.0484 (0.0729) | 0.0849 (0.0692) | 0.185 (0.123) | 0.0550 (0.0390) | 0.0311 (0.0426) | 0.005 (0.108) | 0.119 (0.105) | 0.130 (0.216) | 0.0727 (0.0604) | 0.0622 (0.0648) |
| Total hours of care | | | | | | X | X | X | X | X |
| Other Summer Activities | X | X | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | X | X | X | X | X | X | X | X | X | X |
| Control Variables | X | X | X | X | X | X | X | X | X | X |
| Preschool and Kindergarten Child Care | X | X | X | X | X | X | X | X | X | X |
| Observations | 844 | 773 | 522 | 2197 | 2272 | 844 | 773 | 522 | 2197 | 2272 |
| R-squared | 0.863 | 0.895 | 0.892 | 0.845 | 0.846 | 0.863 | 0.895 | 0.892 | 0.845 | 0.846 |
| Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A. | | | | | | | | | | |
| Models are weighted | | | | | | | | | | |
| *** p<0.01, ** p<0.05 | | | | | | | | | | |

| Table 10. Fixed Effects Regressions Predicting Fall of First Grade Achievement using Summer Child Care and Total Hours of Summer Care | | | | | | | | | | | | | | |
|---|--------------------------------|---------|---------|---------|---------|----------|----------|-----------------------------|---------|---------|---------|---------|---------|---------|
| | Reading Achievement Test Score | | | | | | | Math Achievement Test Score | | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| Summer Child Care | | | | | | | | | | | | | | |
| Center Care | 0.107* | 0.047* | 0.051* | 0.199** | 0.0512 | 0.298*** | 0.099* | 0.0903* | 0.022 | 0.024 | 0.108 | 0.045 | 0.144 | 0.050 |
| | (0.055) | (0.028) | (0.030) | (0.083) | (0.043) | (0.109) | (0.056) | (0.053) | (0.031) | (0.034) | (0.080) | (0.048) | (0.105) | (0.062) |
| Total center hours | | | | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.000 | 0.000 | -0.001 | 0.000 |
| | | | | (0.000) | (0.000) | (0.000) | (0.0002) | | | | (0.000) | (0.000) | (0.000) | (0.000) |
| Total center hours squared | | | | | | 0.000 | 0.000 | | | | | | 0.000 | 0.000 |
| | | | | | | (0.000) | (0.000) | | | | | | (0.000) | (0.000) |
| Other Summer Activities | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | | X | X | | X | | X | | X | X | | X | | X |
| Control Variables | | | X | | X | | X | | | X | | X | | X |
| Preschool and Kindergarten Child Care | | | X | | X | | X | | | X | | X | | X |
| Observations | 1858 | 1845 | 1845 | 1855 | 1843 | 1855 | 1843 | 1888 | 1873 | 1873 | 1885 | 1871 | 1885 | 1871 |
| R-squared | 0.475 | 0.878 | 0.878 | 0.476 | 0.878 | 0.477 | 0.878 | 0.493 | 0.839 | 0.840 | 0.495 | 0.840 | 0.495 | 0.840 |
| Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A. | | | | | | | | | | | | | | |
| Models are weighted | | | | | | | | | | | | | | |
| *** p<0.01, ** p<0.05, *p<.1 | | | | | | | | | | | | | | |

| Table 11. Fixed Effects Regressions Predicting Fall of First Grade Achievement using Summer Child Care by Income | | | | | | | | | | |
|---|---------------------------------------|------------------|-------------------|--------------------|-------------------|------------------------------------|---------------------|-------------------|-------------------|--------------------|
| | Reading Achievement Test Score | | | | | Math Achievement Test Score | | | | |
| | Income Quintile | | | | | | | | | |
| | Bottom (1) | 2 | 3 | 4 | Top (5) | Bottom (1) | 2 | 3 | 4 | Top (5) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Summer Child Care | | | | | | | | | | |
| Center Care | -0.0590 (0.104) | 0.189 (0.125) | -0.177 (0.272) | -0.0465 (0.146) | 0.0984 (0.114) | 0.222 (0.144) | -0.00137 (0.129) | 0.0373 (0.238) | 0.0281 (0.191) | -0.0680 (0.134) |
| Other Summer Activities | X | X | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | X | X | X | X | X | X | X | X | X | X |
| Control Variables | X | X | X | X | X | X | X | X | X | X |
| Preschool and Kindergarten Child Care | X | X | X | X | X | X | X | X | X | X |
| Observations | 411 | 431 | 329 | 355 | 405 | 427 | 444 | 329 | 356 | 404 |
| R-squared | 0.939 | 0.940 | 0.946 | 0.960 | 0.953 | 0.894 | 0.942 | 0.948 | 0.914 | 0.904 |
| Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A. | | | | | | | | | | |
| Models are weighted | | | | | | | | | | |
| *** p<0.01, ** p<0.05 | | | | | | | | | | |

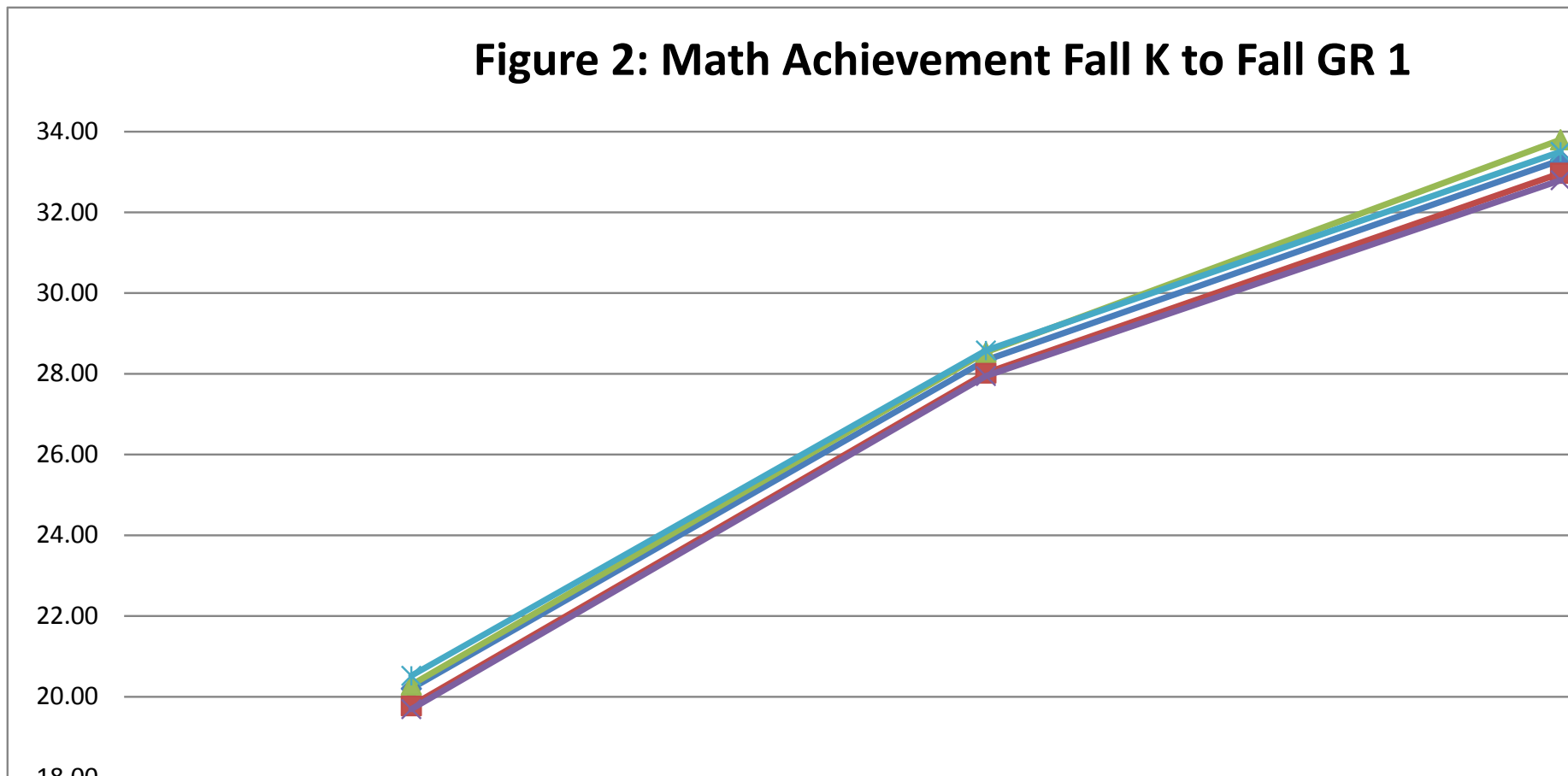
| Table 12. Fixed Effects Regressions Predicting Fall of First Grade Achievement using Summer Child Care by Child and Family Characteristics | | | | | | | | |
|---|----------------------------|----------------------|---------------------|---------------------|-------------------------|----------------------|--------------------|----------------------|
| | Reading Achievement | | | | Math Achievement | | | |
| | Poor | Single Parent | Girls | Boys | Poor | Single Parent | Girls | Boys |
| | (1) | (2) | (4) | (5) | (6) | (7) | (8) | (9) |
| Summer Child Care | | | | | | | | |
| Center Care | -0.211** (0.0948) | 0.0260 (0.0760) | 0.00989 (0.0482) | 0.105** (0.0456) | 0.107 (0.0858) | 0.154 (0.270) | 0.0398 (0.0511) | -0.00681 (0.0560) |
| Other Summer Activities | X | X | X | X | X | X | X | X |
| School Fixed Effects | X | X | X | X | X | X | X | X |
| Fall & Spring of Kindergarten Achievement | X | X | X | X | X | X | X | X |
| Control Variables | X | X | X | X | X | X | X | X |
| Preschool and Kindergarten Child Care | X | X | X | X | X | X | X | X |
| Observations | 338 | 501 | 919 | 926 | 338 | 501 | 919 | 926 |
| R-squared | 0.933 | 0.936 | 0.909 | 0.910 | 0.933 | 0.936 | 0.909 | 0.910 |
| Standard errors in parentheses, outcomes are standardized to the full weighted sample. School fixed effects and weights included in each model. Control variables listed in Table 1 and Appendix A. | | | | | | | | |
| Models are weighted | | | | | | | | |
| *** p<0.01, ** p<0.05 | | | | | | | | |

| Appendix A: Summary Statistics for Additional Control Variables | | |
|---|-------------|-----------|
| Variable | Full Sample | |
| | Mean | Std. Dev. |
| Fall of Kindergarten child characteristics | | |
| Kindergarten Hours per Day | 4.93 | 1.82 |
| Half Day Kindergarten | 0.44 | 0.5 |
| General Knowledge Test Score | 22.89 | 7.38 |
| Approaches to Learning | | |
| | 3.02 | 0.66 |
| Baseline child characteristics | | |
| Birth weight (in pounds) | 7.18 | 1.81 |
| Premature (child over 2 weeks early) | 0.17 | 0.37 |
| Home Environment | | |
| Four or more moves pre-school | 0.12 | 0.33 |
| Parent reads to child (days/week) | 5.13 | 2.05 |
| Parent tells stories to child (days/ week) | 3.74 | 2.39 |
| Parental Characteristics | | |
| Mother's age at child's birth | 27.26 | 7.4 |
| Mother's age at first birth | 22.68 | 7.88 |
| WIC | 0.42 | 0.49 |
| Food Stamp | 0.28 | 0.45 |
| AFDC | 0.19 | 0.39 |
| Parental expectations at baseline | | |
| Years of education parent expects child to complete | 16.11 | 2.33 |
| How important is it that your child does the following by kindergarten? (1="Essential", 5="Not Important") | | |
| Count | 2.34 | 0.9 |
| Share | 1.71 | 0.58 |
| Draw | 2.08 | 0.78 |
| Be calm | 1.94 | 0.69 |
| Knows letters | 2.2 | 0.84 |
| Communicates well | 1.7 | 0.59 |

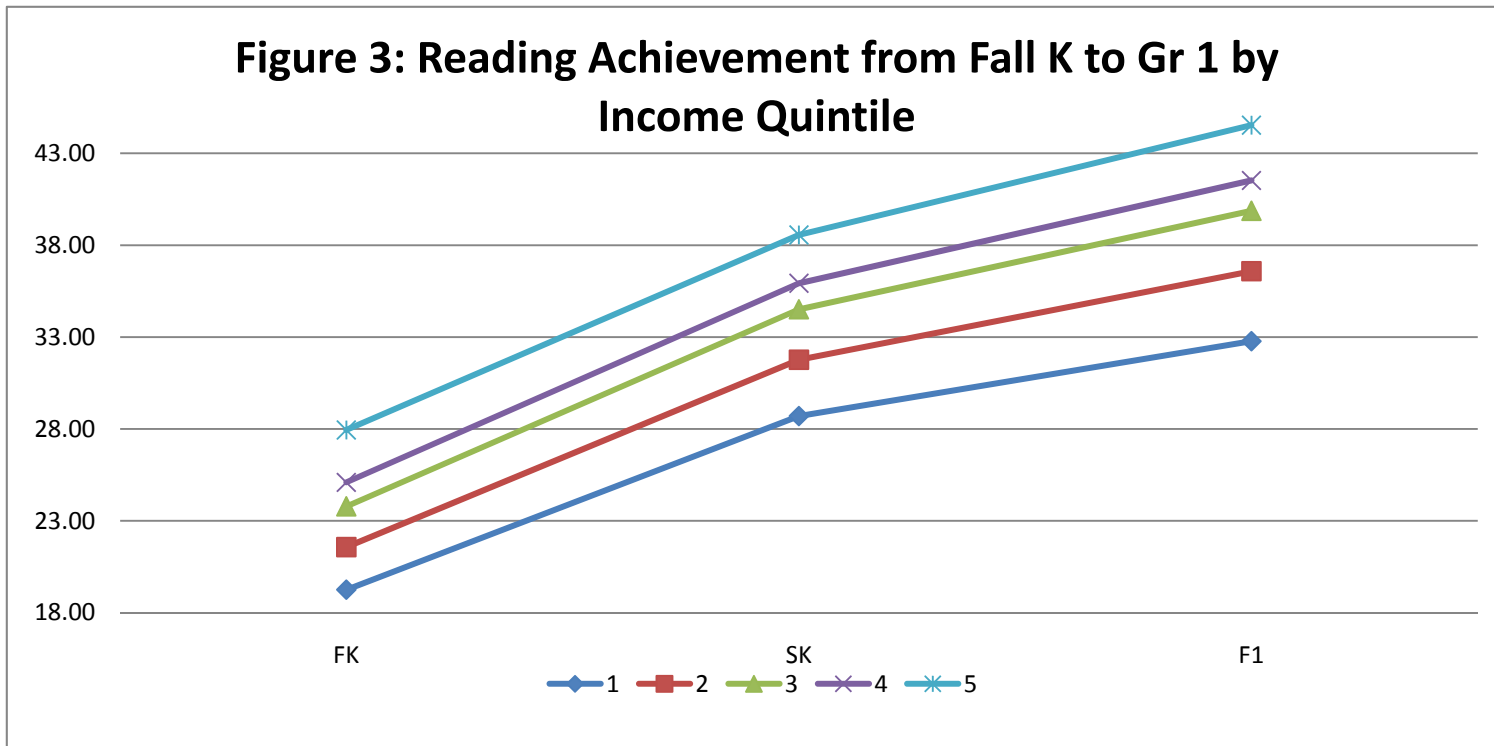


Caption: Unadjusted reading achievement test scores

Figure 2: Math Achievement Fall K to Fall GR 1

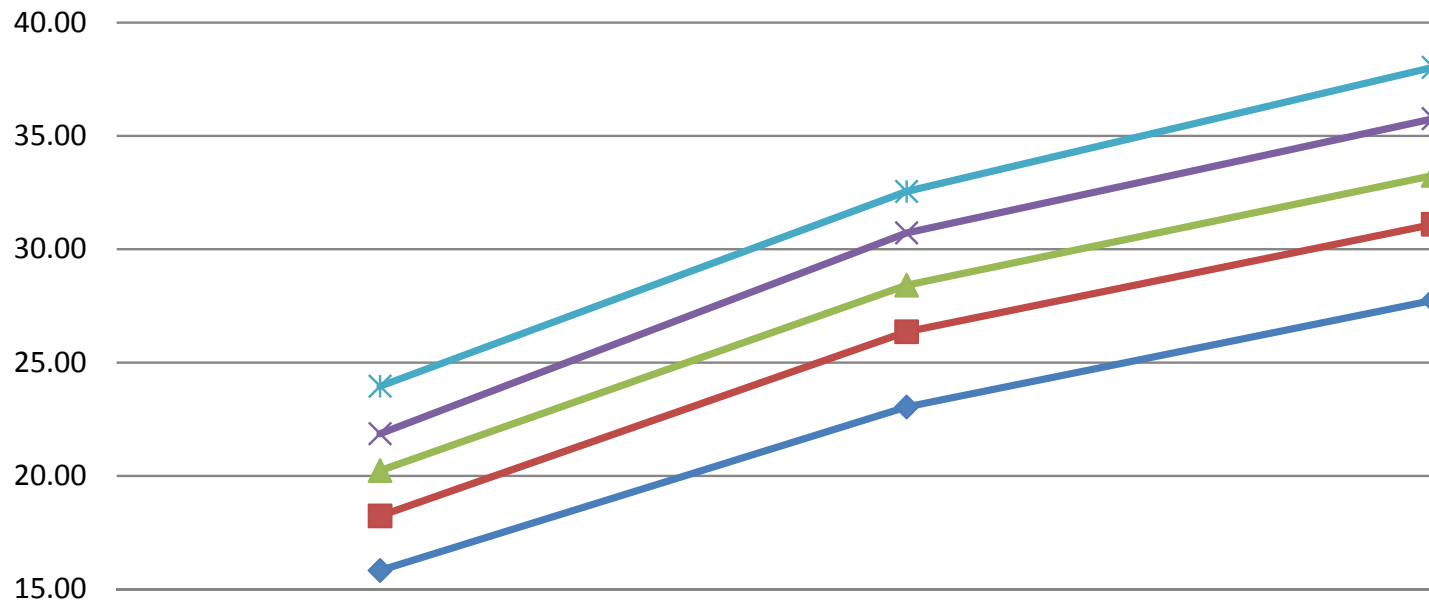


Caption: Unadjusted math achievement test scores



Caption: Unadjusted reading achievement test scores. 1=lowest income, 5=highest income

**Figure 4: Math Achievement from Fall K to Fall GR 1
Income Quintile**



Caption: Unadjusted math achievement test scores. 1=lowest income, 5=highest income