

How much is too much?

The Effects of Duration and Intensity of Child Care Experiences on
Children's Social and Cognitive Development

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Introduction

Much debate surrounds the issue of how best to raise children's school achievement. Research on cognitive development indicates that one of the most effective interventions may be formal center-based care or preschool participation, before formal schooling has begun (Shonkoff & Phillips, 2000; Heckman, 2000). In fact, approximately two-thirds of four-year-olds attend center programs before starting kindergarten (U.S. Department of Education, 2003), although the extent of exposure to these programs and the quality of the care varies dramatically. This paper extends previous research conducted by Magnuson, Ruhm, & Waldfogel (2004) to consider the effects of different child-care arrangements on children's social and cognitive skills at the start of kindergarten, focusing on how the intensity of children's participation is related to program effects. It also addresses differences in program effects across income groups. These issues are germane to recent debates over implementing universal preschool, as policy makers consider age-eligibility and whether programs should be half-day or full-day.

In this paper we address the following questions:

- Does center care and/or Head Start improve children's cognitive and social-behavioral outcomes at kindergarten entry, after considering their family background and neighborhood characteristics?
- Does age at entry or intensity of exposure to center care affect children's cognitive and social-behavioral outcomes?

Achievement Gaps: School readiness is of particular concern for those children at risk for low school achievement. Disparities between groups in a wide range of domains are already evident at kindergarten entry, across social class and ethnic groups (Jencks & Phillips, 1998; Reardon, 2003; Rumberger and Arellano, 2003; Wertheimer, Croan, Moore, & Hair, 2003). For example, the difference between African-American and White children in their early language and cognitive

development is equal to the approximate amount that children learn during two to three months of kindergarten (Jencks & Phillips, 1998; Reardon, 2003). English-proficient Latino five-year-olds in California were also estimated to be about 0.38 of a standard deviation (SD)—or two to three months—behind White youngsters in pre-reading and math skills (Rumberger and Arellano, 2003).

Similar achievement gaps exist between children from poor and affluent families. Research indicates that children in the lowest socioeconomic group are several months behind their middle-class peers in pre-reading and pre-math skills at kindergarten entry. This chasm almost triples when poor children are compared to the most affluent fifth (Bridges, Fuller, Rumberger, & Tran, 2004). These disparities between groups often grow even larger over the course of their schooling (Jencks & Phillips, 1998; Fryer & Levitt, 2004).

Child-Care Arrangements that Contribute to Outcomes: Research indicates that attending high-quality child-care boosts children’s developmental trajectories, leading to speculation about the possibility of its closing achievement gaps (Barnett, 1995; Bridges et al., 2004; Brooks-Gunn, 2000; Currie, 2001; Waldfogel, 2002). Researchers have compared various care arrangements to determine which might hold the most promise for improving children’s cognitive and social-behavioral outcomes; center-based programs appear to offer the most benefits (Loeb, Fuller, Kagan, & Carrol, 2004). Participating in center-based care has been associated with immediate and long-term benefits for children (Barnett, 1995; Campbell & Ramey, 1995). Head Start, which is differentiated by having particular regulations and serving a distinct population of the most disadvantaged children, also has been shown to improve children’s outcomes in both the short and long term, though the evidence is mixed (Currie & Thomas, 2000; Garces, Thomas, & Currie, 2002).

Children from socioeconomically disadvantaged homes often exhibit the greatest gains from participating in center programs (Burchinal, Campbell, Bryant, Wasik, & Ramey, 1997; Campbell & Ramey, 1994). Center-based care may also benefit English-language learners; given that research has

indicated these children are less likely than others to experience home literacy practices found to facilitate early learning (August & Hakuta, 1999; Loeb, Fuller, & Kagan, 2004; Snow, Burns, & Griffin, 1998).

Some studies have also found that although children experience cognitive gains in centers, other aspects of their school readiness—positive social behaviors and impulse control—suffer (Belsky, 2001; NICHD ECCRN, 2003). While some evidence suggests that increases in hours spent in center care increases behavioral problems (NICHD ECCRN, 2003), it is less clear what the tradeoff is between social problems and cognitive gains as hours increase. In addition, it is not clear how these effects differ for children with different background characteristics.

Differences in Types of Care: Children participate in a wide variety of care arrangements, which are differentially associated with their outcomes. In this paper, we consider four mutually exclusive arrangements: center care, Head Start care, parental care, and non-parental care (which includes non-parent relatives or non-relatives, such as babysitters). Though parents in the data we use were asked to specify the type of center care their child attended—a day-care center, a preschool, a nursery school, or a Pre-K program—differences between the four types are often difficult for parents to distinguish so we do not rely on these self-reports to distinguish center types (Kisker, Hofferth, Phillips, & Farquhar, 1991).

Differences in Access: In spite the range of child-care arrangements available, children's access varies markedly in predictable ways. Participation in center-based programs increases with social class: children from affluent families are much more likely to receive center care than children from other SES groups (O'Brien-Strain, Moye, & Sonenstein, 2003; Reardon, 2004). For example, more than 70 percent of upper middle-class children attend center-based programs before starting kindergarten, compared to 45 percent of those from low-income families (Hofferth, Shauman, Heake & West, 1995).

However, with the expansion of Head Start and state preschool programs, children from low-income families are increasingly participating in center-based programs before school entry (Smith, 2003). In fact, it may be that working-class families have less access to preschool than their poor counterparts because they are just above the income threshold for child care subsidies, yet cannot afford the high monthly fees (Fuller & Huang, 2003; Fuller, Livas, & Bridges, 2005).

Ethnic disparities in preschool access remain dramatic: Latino parents enroll their children in preschool centers at a rate 23 percentage points below the enrollment rate of African-American children, and 11 percent below Whites even after taking into account maternal employment status (Liang, Fuller & Singer, 2000). Asian American children, too, participate in preschool at substantially lower rates than do Whites or African Americans (NCES, 1998).

Differences in Exposure: The effect of different non-parental care arrangements on children is likely based in part on the amount of time children are exposed to them. This might be thought of as a “dosage” effect and can be conceptualized as the age at entry and intensity of attendance. Children entering at younger ages or attending for more hours per week may exhibit greater benefits—or greater detriments—than those with later or less exposure. Little is known about the amount of exposure that maximizes cognitive gains for children. Research on interventions to improve cognitive outcomes suggests early intervention is best (Shonkoff & Phillips, 2000). Some research, however, has indicated that children spending long hours or more months of the year in center care exhibit increases in problem behavior (Bates, Marvinney, Kelly, Dodge, Bennett, & Pettit, 1994; Belsky, 2001; NICHD ECCRN, 2003).

Additions to the Literature: In addition to using a representative sample of English-proficient children, this study extends previous research on child care in the following ways. First, it assesses the duration effect of center-care experiences to ask, “what is the optimal age at which to enter center programs?” Second, it looks at the intensity effect, asking whether there is some

number of hours per week of attendance that has a more positive effect than either greater or lesser exposure. Third, we look at both these effects by the income of the child's family, asking whether center care experiences are more or less important for children from different groups. All three of these questions are central to the current discussion of universal preschool. In addition, we run numerous specification checks, including an instrumental variables analysis and propensity score matching to assess selection bias.

Data

Data for this study come from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K). ECLS-K follows a nationally representative cohort of children from kindergarten entry through fifth grade. Our study includes 14,162 children who entered kindergarten for the first time in 1998. We exclude children who were missing scores on any of the assessments, as well as those children for whom we have no child care information.

Child Care Measures: In the fall of the kindergarten year, parents were asked a series of questions regarding their child's care arrangement in the year prior to kindergarten entrance. Based on their responses, we created four mutually exclusive child-care arrangement groups; center care, Head Start care, parental care and non-parental care (which includes care by non-parent relatives or non-relatives such as a babysitter). Though parents were asked to specify whether their child went to a day care center, a preschool, a nursery school or a Pre-K program, we were concerned that the differences between the four center types were difficult for parents to distinguish. We therefore created a single center care group that includes children who went to any type of child care center with the exception of Head Start. If parents indicated that their child received care at multiple settings, we coded them as follows: if a child attended center care in combination with parental or non-parental care, they were placed in the center care group. Similarly, if a child attended Head Start

in combination with parental or non-parental care, he was placed in the Head Start group. Finally, if a child participated in center care as well as a Head Start program, we placed her in the group in which she spent more hours per week.¹

In order to test whether the amount of center exposure made a difference in children's outcomes, we created a series of *age of entrance* and *intensity* variables. To get at the impact of early entrance, we created indicator variables for the child's age when he first entered center care (age 0-1, 1-2, 2-3, 3-4, 4-5, greater than 5, and unknown). We also created two intensity variables: the first dummy variable indicates whether the child attended center care for 15 to 30 hours per week and nine months out of the year; the second raises the weekly hours to at least 30 hours per week and at least nine months. We created these distinctions in keeping with the typical half-day program and the typical full-day program.

Outcomes: In the fall of kindergarten, one-on-one child assessments were conducted to assess reading and mathematics ability. The reading assessment measures a variety of skills including print familiarity, letter and word recognition, beginning and ending sounds, rhyming sounds, vocabulary, and comprehension. The math test evaluates each child's knowledge of numbers as well as their spatial sense and problem solving abilities². The assessments in each subject area were administered in two stages, the first involved a routing test, and the second involved items at the appropriate difficulty level. In our analysis we use standardized T-Scores. These scores are transformations of ability scores that have been rescaled with a mean of 50 and a standard deviation of ten. T-Scores are norm-referenced measures of achievement and provide an indicator of how each individual child is doing relative to the national average.

¹ We were also concerned that parents might misreport Head Start attendance. However, ECLA-K independently confirms Head Start attendance. As a specification check we reassigned to the center care group those who reported attending Head Start but were not confirmed as attending Head Start.

² Early Childhood Longitudinal Study, Kindergarten Class of 1998-99. ECLS-K Base Year Data Files and Electronic Code Book.

In addition to assessing cognitive outcomes, our study considers children's social skills as reported by kindergarten teachers through a self-administered questionnaire. Teachers were asked to evaluate the social skills of the sampled children in their classroom on a scale from one to four with respect to their approaches to learning, self-control and a variety of interpersonal skills. Using factor analysis we created a composite score that combines measures of self control, interpersonal skills, and externalizing behavior (Chronbach's alpha of 0.87). The behavior score is standardized with mean of zero and a standard deviation of 10.

Other Variables: In order for the results to be comparable with Magnuson, Ruhm, & Waldfogel (2004), we use the same set of ECLS-K variables as controls in the analyses. Appendix Table 1 lists these numerous measures. In addition, in order to capture neighborhood effects, we include a set of zip code level variables, aggregated from the Long Form of the 2000 Decennial Census. Appendix Table 2 lists these variables, capturing community characteristics.

Table 1 gives the means and standard deviations of a subset of the variables for the full sample and separately for each child care type. We see that about 64 percent of the children attended center care, compared with 17 percent in parental care, eight percent in Head Start and 12 percent in other non-parental care. Children in Head Start were somewhat more likely to come from the southern region of the country and were substantially more likely to be black. Center care is more evenly distributed across the country, but Hispanic children are less likely to attend. Large differences in socio-economic status are evident across child care types, as well. Children in Head Start have lower weight at birth, are more likely live in a single-parent family, are more likely to have parents without high school degrees, are more likely to have participated in WIC, and come from lower income families. Parents who provide the sole care for their children are, not surprisingly, less likely to be single parents and less likely to work full time. Children in center care are more likely to

speak English only at home and have more highly educated parents. Children with other non-parental care are more likely to come from families in which the mother works full time.

In addition to social status difference, children vary in home life by child care setting. For example, children in Head Start have the least number of children’s books in their home, while those in other centers have the most. Children in Head Start watch the most television, while those in centers watch the least. Children in Head Start are most likely to be spanked, while those in center care are least likely. Parents of children in Head Start are least likely to attend a parent-teacher conference during kindergarten or volunteer at school; those in center care are most likely.

Methodology

Our goal is to assess the effects of child care on children’s social and cognitive development at the start of kindergarten. Unfortunately, as noted above, there are substantial differences in the characteristics of children across settings. The heart of our analysis relies on the rich measures of children and families available in the ECLS-K to adjust for differences across child care settings using a regression framework. Equation 1 summarizes this approach:

$$Y_{isz} = \alpha_0 + C_{isz} \alpha_1 + X_{izx} \alpha_2 + Z_{zsz} \alpha_3 + \pi_s + \varepsilon_{isz} \quad (1)$$

The outcome (Y) of child (i) in zipcode (z) and state (s) is a function of child care type (C), child and family characteristics (X), zipcode characteristics (Z), state fixed effects (π), and a random and normally distributed error term (ε). Child care type in the base model is a series of three dummy variables for center care, Head Start and other non-parental care in comparison to parental care. In the models assessing duration, child care type is expanded to include the duration of center care. The center care dummy variable, in this case, is replaced by seven dummy variables measuring starting center care at age zero to one year, one to two years, two to three years, three to four years, four to five years, greater than five years, and start date unknown. In the model assessing intensity

the center care dummy is supplemented by mutually exclusive dummy variables for attendance of 15 to 30 hours per week for at least nine months per year and for attendance of at least 30 hours per week for at least nine months per year.

There are some limitations of this approach. For example, regression often assumes a linear relationship among variables when the relationship is meaningful but non-linear. The bias created by this misspecification can be larger when there is less overlap across treatments, as is the case for child care type. For example, we may estimate the effect of income on child outcomes using data that is mostly over one income range; the group of children in this income range will be most important for determining the estimate. If children in a particular care type (for example Head Start) have much different income then we may apply estimates that are inaccurate for this group. We mitigate the potential bias from misspecification by using multiple dummy variables instead of continuous variables for measures such as education and income (see Appendix Table 1). In addition we check whether we have adequately adjusted for these non-linearities and lack of overlap by using statistical matching of children across child care type. We use kernel matching, a non-parametric matching approach that creates matches for the treatment using (biweight) kernel weighted averages of those not in the treatment (Heckman, Ichimura and Todd 1998).³

Analyses that assess treatment effects with non-experimental data are often subject to omitted variables bias. As discussed above, we reduce this possibility in these analyses by using an unusually rich set of control variables. In addition, we gathered a variety of zip code and state level data with the goal of using instrumental variable (IV) models to adjust for selection. In particular, we obtained counts of child care establishments and community organizations at the zip code level. Given the extensive set of zip code level controls from the census, we posited that these measures

³ This gives very similar results to the simple procedure of predicting treatment probabilities, P , as a function of all the other right-hand-side variables in Equation 1 using a probit and then creating a weight that is one for those in the treatment and $P/(1-P)$ for those not in the treatment.

would predict center use but not child outcomes. We also obtained a number of state-level measures to capture state intervention. We created three variables that measure state level spending on child care: each state's 1999 spending on pre-Kindergarten, Head Start, and the child care component of their Temporary Assistance to Needy Families (TANF) is divided by the number of children under 5 years of age living in poverty⁴. Finally, we included measures for the income cutoff for state child care assistance both as a level and as a percentage of the state median⁵. These variables were meant to capture each state's commitment to child care provision, particularly for poor children. Unfortunately, while the difference between the IV estimates and the OLS estimates are not statistically significant and the IV estimates are in the same direction as the OLS estimates, the standard errors are too large to draw any meaningful conclusions from the IV analyses.

Results

Table 2 presents four models for each of the three student outcomes. Model 1 includes only the child care variables; Model 2 introduces the family and child controls for ECLS-K; Model 3 adds in zip code demographics; and Model 4 includes state fixed effects. Across outcomes, we see that the inclusion of the ECLS-K controls dramatically changes the estimates of the Head Start coefficient across all outcomes, as well as the estimates of the center care coefficients for reading

⁴ Head Start and Pre-Kindergarten spending figures are taken from Blank, Helen. Karen Schulman and Denielle Ewan. "Seeds of Success," Children's Defense Fund, September 1999.

http://www.childrensdefense.org/pdf/seeds_of_success.pdf

TANF spending figures for 1999 are available at the US Department of Health and Human Services Website. See: http://www.acf.dhhs.gov/programs/ofs/data/tableB_1999.html

Percentage of the population under five in poverty is taken from census data available from Geolytics: 2000 Long Form DVD.

⁵ Data on 2001 income cutoffs for state child care assistance comes from Schulman, Karen, Helen Blank. "Child Care Assistance Policies 2001-2004: Families Struggling to Move Forward, States Going Backward." National Women's Law Center. September 2004.

<http://www.nwlc.org/pdf/childcaresubsidyfinalreport.pdf>

For states that have a range of cutoffs throughout the state we used the lower end of the range, so that any estimates of a relationship between cutoffs and child care choice is conservative.

and math. The addition of the zip code controls and the state fixed effects do not have as strong an effect.

The results provide evidence that center care improves children's reading and math skills but also increases behavioral problems relative to parental care. The center care coefficient for reading suggests that center care attendance increases reading skills by 1.1 points. The standard deviation in reading is 10.0; thus the point estimate implies a .11 standard deviation increase. The results are very similar for math. Center care is associated with a 1.2 point (.12 standard deviation) increase in math performance. The estimation of social development show negative effects of center care. Center attendance in Model 4 is associated with a 0.095 point (measured in standard deviation units) decrease in the behavioral index.

The Head Start effects estimated in Table 2 are not statistically different from zero for either reading or math, though they do suggest a negative effect of Head Start on behavior. Children in Head Start exhibit behavior that is about 0.12 standard deviations below children in parental care. One caution about the Head Start effects is that additional controls, moving from Model 1 to Model 4 continue to increase the association between Head Start and all three child outcomes. This may be an indication of continued omitted variables bias and that additional controls are needed to adequately estimate Head Start effects.

As discussed above, we use both instrumental variables and propensity score matching to test the specification of the models. Table 3 shows that our instruments were not successful in accurately estimating child care effects. However, the statistical matching results are quite similar to those discussed above. Relative, in this case, to both parental and other non-parental, non-Head Start care center attendance is associated with a .13 standard deviation increase in reading and math performance and decrease in the behavioral measure.

Many studies have postulated that the effects of center care will differ across families. For example, children in families with many resources for early math and reading may not benefit as much from center care as those in families without such resources. Table 4 presents the results of the Model 4 estimates from Table 2, but separately for children from families in the lowest income-to-needs ratio quartile, the middle half and the top quartile. There is surprising little difference across income groups. With few exceptions, center care appears to benefit reading and math learning and harm behavior. We also ran these results using weights from the propensity score matching described above (see Appendix Table 3). The results are very similar to the OLS results indicating that the limited overlap in our sample across child care types is unlikely to be biasing our results.⁶

Next we move onto the focus of our study, the effects of duration and intensity of center care. Table 5 gives the results of the duration measure. The first column provides the results of estimates using the full sample of children. The greatest benefit of center care for reading and math skills accrues to children who start center-based programs between the ages of two and three. Interestingly, those who start both before and after that time appear to gain less, though except for those who entered after age five, attending a center is still associated with higher scores than parental care. The results for behavior are different, though perhaps predictable. The negative behavioral effects are greater the earlier a child enters. The difference in the relationship between center duration and achievement in comparison to center and behavior suggests that simple selection bias is unlikely to be biasing the results. If particularly strong families put their kids in center care at a given age and we were not able to adjust for that with the many controls, we would expect to see the

⁶ The results are slightly different for high income reading results and the middle income behavior results but this is solely do to differences between parental and other non-parental care. Parental care is the comparison group for the OLS results, while the combination of parental and non-parental care is the comparison for the statistical matching results.

highest scores across all three measures for children associated with the duration of center attendance. This is not the case; the behavioral effects differ from the cognitive effects.

The final three columns of Table 5 give the results separately for the lowest quartile, middle half and highest quartile of the income-to-needs ratio. Again the results are similar across the income groups. For all three groups, the strongest reading and math effects occur for those who enter centers between the ages of two and three, and the worst behavioral effects occur for those who enter the earliest.

Duration or starting date of center care is one dimension for measuring the amount of center care a child receives. However, children differ meaningfully in how much time they spend in center care during a given year. Table 6 looks at the effect of intensity of care using dummy variables to capture whether a child attended a center for between 15 and 30 hours per week for at least nine months per year or for greater than 30 hours per week for at least nine months per year. In this case, the coefficient on the center care dummy variable picks up the effect of any center attendance and should be added to the coefficients on the measures of intensity to get the total effect of intense attendance relative to parental care. The first column presents the results for the full sample. These estimates suggest that some intensity, at least 15 hours per week, substantially increases the contribution of center care to student learning but that there is little evident difference between the scores of those who attend for 15 to 30 hours per week and those that attend for greater than 30 hours. However, differences are evident in the behavioral index. Not only do the negative behavioral effects appear for those with at least 15 hours of care per week but additional care -- as measured by at least 30 hours of center care -- approximately doubles this negative effect.

The estimates for the full sample obscure interesting differences across income groups. In particular for the lowest income group, reading and math achievement do increase with additional care, not only going from less than 15 hours to more than 15 hours, but also going from 15 to 30

hours to more than 30 hours. In addition, the negative effect of center care on behavioral outcomes does not increase in a qualitatively important or statistically significant way with additional hours of care. On the other extreme, children from higher income families score lower in reading and math when they attend centers for more than 30 hours per week than they do if they attend for 15 to 30 hours. In addition, unlike the lower-income children, these children from higher income families demonstrate increasingly bad behavior the longer they are in center care each week.

Conclusion

This paper asks, “how much is too much center-based child care?” Evidence from ECLS-K suggests that center care is associated with gains of about .1 standard deviations in math and reading, though it is also associated with approximately the same size negative effect on a teacher-reported behavioral measure that captures approaches to learning, self-control and a variety of interpersonal skills. These differential effects suggest further exploration of the characteristics of center attendance that effect cognitive and social outcomes. Is there a type of center care that maximizes the positive cognitive effects while minimizing the negative social effects? In this paper we have looked at the amount of center care, both duration and intensity, that a child experiences. Certainly the quality of the center care is another aspect worth addressing (see for example, Loeb, Fuller, Kagan, & Carrol, 2004). Unfortunately, while the ECLS-K data provides a national view of child care use and kindergarten preparedness not available from other sources, it does not have information on the quality of care across child care types.

We found consistent effects of the duration of center care attendance across income groups. The data indicate that the greatest benefits of center care are for those who enter center-based programs between the ages of two and three years old. Children who start earlier do not display greater math and reading skills, and, in fact, in the sample the predicted averages are somewhat

lower than for those who start between two and three. In addition, the negative behavioral effects associated with center attendance, relative to parental care, are much greater for those who start care at less than two years of age and are particularly large for those who start at less than one year of age. For both low and high income children, starting center care before the age of two is not particularly beneficial for cognitive development and appears to be detrimental for behavior.

The results for the intensity of center care are more subtle, differing by income group. For children from low-income families, additional hours per week are associated with gains in reading and math and very little behavioral detriment. However, while high income children see reading and math gains associated with moderate levels of care (15 to 30 hours per week), they see no cognitive gains and substantially greater behavioral problems associated with additional hours of center care.

While these results do not provide cost-benefit analyses of universal preschool or center-based child care programs that target children with particular background characteristics, they do provide evidence of the benefit of center care for children from families at all income levels. They also suggest that greater benefits can accrue from interventions that start earlier than the age of four. Generally, children learn more when they start between two and three years of age. In addition, while half day programs may be beneficial for children from higher income families, full day programs better serve children from lower income families, allowing them to gain reading and math skills without detriment to social behavior.

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Table 1: Descriptives of Selected Variables by Child Care Type

	All	Parental	Center	Head Start	Other
Sample Size	14162	2363	9015	1093	1691
South	0.37	0.38	0.36	0.44	0.34
Birth Weight	118(21)	118(22)	119(21)	114(23)	117(21)
Race/Ethnicity					
Black	0.16	0.12	0.14	0.39	0.13
Hispanic	0.13	0.17	0.11	0.19	0.18
English Only at Home	0.84	0.80	0.86	0.80	0.81
Single parent family	0.22	0.16	0.20	0.43	0.28
Mother's Education					
<HS	0.10	0.19	0.06	0.24	0.12
HS	0.31	0.36	0.27	0.44	0.37
Vocational	0.06	0.06	0.05	0.06	0.06
BA	0.16	0.10	0.20	0.02	0.10
Some Grad	0.02	0.01	0.02	0.01	0.01
MA	0.05	0.02	0.06	0.00	0.03
PhD	0.01	0.00	0.02	0.00	0.01
Mother Employed					
Full Time	0.46	0.24	0.48	0.44	0.65
Part Time	0.22	0.21	0.23	0.18	0.17
Father Employed					
Full Time	0.70	0.73	0.74	0.44	0.67
Part Time	0.03	0.03	0.03	0.03	0.03
WIC Participation	0.45	0.49	0.37	0.89	0.52
Income to Needs					
< .5	0.07	0.08	0.04	0.22	0.06
.5-1.0	0.11	0.14	0.08	0.29	0.13
Home: # of children's books	78(59)	72(58)	85(60)	49(48)	69(56)
computer	0.59	0.53	0.65	0.30	0.52
tv hours	1.84(1.20)	1.96(1.25)	1.73(1.12)	2.22(1.42)	1.98(1.28)
visited zoo	0.40	0.39	0.41	0.37	0.39
visited library	0.55	0.53	0.57	0.46	0.49
dance lessons	0.18	0.12	0.22	0.10	0.14
sports lessons	0.49	0.39	0.56	0.28	0.41
spanked	0.20	0.22	0.18	0.27	0.23
build things	2.36(0.92)	2.43(0.94)	2.34(0.90)	2.43(1.00)	2.31(0.92)
art	2.67(0.87)	2.69(0.89)	2.67(0.85)	2.63(0.95)	2.67(0.86)
games	2.81(0.82)	2.83(0.85)	2.81(0.80)	2.81(0.89)	2.81(0.81)
chores	3.31(0.86)	3.33(0.90)	3.30(0.84)	3.40(0.90)	3.31(0.85)
sports	2.69(0.91)	2.76(0.95)	2.66(0.88)	2.78(1.00)	2.68(0.93)
nature	2.22(0.88)	2.23(0.89)	2.25(0.86)	2.09(0.92)	2.18(0.88)
Parent at School:					
PTA meeting	0.34	0.36	0.35	0.30	0.27
Parent-Tchr conference	0.86	0.83	0.88	0.79	0.84
Volunteered	0.50	0.50	0.55	0.31	0.42

Table 2: OLS Estimates of the Effects of Child Care Settings on Cognitive and Behavioral Outcomes

	(1)	(2)	(3)	(4)
Reading				
Center Care	3.853*** (0.217)	1.275*** (0.217)	1.197*** (0.218)	1.102*** (0.219)
Head Start Care	-4.054*** (0.332)	-0.625* (0.335)	-0.629* (0.339)	-0.494 (0.343)
Other Non-Parent Care	-0.489 (0.299)	-0.424 (0.293)	-0.427 (0.295)	-0.442 (0.296)
Child & Family Characteristics		Yes	Yes	Yes
Zip Code Demographics			Yes	Yes
State Fixed Effects				Yes
Observations	14162	11834	11710	11577
R-squared	0.07	0.34	0.35	0.36
Math				
Center Care	3.495*** (0.211)	1.320*** (0.207)	1.257*** (0.208)	1.207*** (0.210)
Head Start Care	-3.884*** (0.322)	0.097 (0.320)	0.127 (0.325)	0.253 (0.329)
Other Non-Parent Care	-0.196 (0.291)	0.136 (0.280)	0.116 (0.282)	0.165 (0.284)
Child & Family Characteristics		Yes	Yes	Yes
Zip Code Demographics			Yes	Yes
State Fixed Effects				Yes
Observations	14162	11834	11710	11577
R-squared	0.06	0.36	0.36	0.37
Behavior				
Center Care	-0.096*** (0.023)	-0.091*** (0.025)	-0.092*** (0.025)	-0.095*** (0.026)
Head Start Care	-0.414*** (0.035)	-0.125*** (0.039)	-0.128*** (0.040)	-0.120*** (0.040)
Other Non-Parent Care	-0.011 (0.031)	0.098*** (0.034)	0.100*** (0.034)	0.101*** (0.035)
Child & Family Characteristics		Yes	Yes	Yes
Zip Code Demographics			Yes	Yes
State Fixed Effects				Yes
Observations	14162	11834	11710	11577
R-squared	0.01	0.13	0.13	0.14

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Specification Checks of the Effects of Child Care Type on Cognitive and Social Outcomes

	Instrumental Variables Results		
	Reading	Math	Behavior
Center Care	10.407** (5.082)	6.613 (4.610)	-0.816 (0.568)
Head Start Care	-2.095 (6.220)	-2.789 (5.642)	-1.481** (0.695)
Other Non-Parent Care	6.150 (4.137)	3.784 (3.752)	-0.544 (0.462)
R-squared (n=9490)	0.22	0.31	0.02
	Statistical Matching Results		
	Head Start Children Excluded		
	Reading	Math	Behavior
Center Care (n=10763)	1.289*** (0.157)	1.255*** (0.148)	-0.134*** (0.018)
R-squared	0.34	0.34	0.13
	Center Care Children Excluded		
	Reading	Math	Behavior
Head Start (n=3992)	-.453* (0.234)	0.257 (0.234)	-0.155*** (0.029)
R-squared	0.34	0.34	0.13

Models include all child/family controls and zip controls as well as dummy variables for Head Start participation and other non-parental care. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Estimates of the Effects of Child Care Settings on Cognitive and Behavioral Outcomes by Income Group (lowest quartile, middle half, upper quartile)

	<i>Low</i>	<i>Middle</i>	<i>High</i>
	Reading		
Center Care	0.620 (0.432)	1.272*** (0.304)	0.806 (0.586)
Head Start Care	-0.821 (0.504)	0.120 (0.589)	
Other Non-Parent Care	-0.316 (0.585)	-0.280 (0.407)	-0.882 (0.765)
Observations	2670	5891	3016
R-squared	0.28	0.30	0.33
	Math		
Center Care	1.188*** (0.442)	1.182*** (0.289)	1.011* (0.544)
Head Start Care	0.514 (0.515)	0.097 (0.560)	
Other Non-Parent Care	0.231 (0.598)	0.410 (0.387)	-0.495 (0.710)
Observations	2670	5891	3016
R-squared	0.29	0.30	0.32
	Behavior		
Center Care	-0.158*** (0.054)	-0.014 (0.035)	-0.176** (0.068)
Head Start Care	-0.103 (0.062)	-0.141** (0.067)	
Other Non-Parent Care	-0.027 (0.072)	0.166*** (0.047)	0.080 (0.089)
Observations	2670	5891	3016
R-squared	0.18	0.14	0.15

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%
Models similar to fourth model in Table 2 plus including a continuous measure of income-to-needs.

Table 5: OLS Estimates of the Effects of Age at Center Entry on Cognitive and Social Outcomes By Income Group

	All (11710)	Low (2670)	Middle (5891)	High (3061)
Reading				
Started Center Age 0-1	1.079*** (0.366)	0.029 (0.887)	1.278** (0.529)	0.235 (0.751)
Started Center Age 1-2	1.207*** (0.404)	0.228 (0.927)	1.265** (0.584)	0.400 (0.817)
Started Center Age 2-3	1.912*** (0.323)	1.608** (0.781)	1.918*** (0.484)	1.301* (0.669)
Started Center Age 3-4	1.412*** (0.263)	-0.119 (0.608)	1.720*** (0.362)	0.987 (0.619)
Started Center Age 4-5	0.994*** (0.268)	1.188** (0.564)	0.923** (0.358)	0.317 (0.684)
Started Center Age >5	0.266 (0.550)	-0.492 (1.136)	0.836 (0.729)	-0.653 (1.309)
Math				
Started Center Age 0-1	1.503*** (0.350)	0.212 (0.906)	1.529*** (0.503)	1.240* (0.696)
Started Center Age 1-2	0.940** (0.386)	0.492 (0.947)	1.035* (0.555)	0.402 (0.758)
Started Center Age 2-3	1.777*** (0.310)	2.388*** (0.798)	1.565*** (0.461)	1.251** (0.621)
Started Center Age 3-4	1.371*** (0.251)	0.71 (0.622)	1.360*** (0.345)	1.400** (0.575)
Started Center Age 4-5	1.059*** (0.257)	1.568*** (0.576)	0.971*** (0.341)	0.197 (0.635)
Started Center Age >5	0.870* (0.526)	0.973 (1.161)	0.884 (0.693)	0.416 (1.214)
Behavior				
Started Center Age 0-1	-0.289*** (0.043)	-0.345*** (0.110)	-0.161*** (0.060)	-0.387*** (0.087)
Started Center Age 1-2	-0.205*** (0.047)	-0.209* (0.115)	-0.149** (0.067)	-0.292*** (0.095)
Started Center Age 2-3	-0.156*** (0.038)	-0.252*** (0.097)	-0.075 (0.055)	-0.229*** (0.078)
Started Center Age 3-4	-0.103*** (0.031)	-0.190** (0.075)	-0.02 (0.041)	-0.164** (0.072)
Started Center Age 4-5	-0.032 (0.031)	-0.09 (0.070)	0.029 (0.041)	-0.085 (0.080)
Started Center Age >5	-0.081 (0.064)	-0.279** (0.141)	0.03 (0.083)	-0.054 (0.152)

Models include all child/family controls and zip controls as well as dummy variables for Head Start participation, unknown center start date, and other non-parental care. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Models 2, 4, and 6 include state fixed effects and the income to needs ratio.

Table 6: OLS Estimates of the Effects of “Intense” Center Care on Cognitive and Behavioral Outcomes

	All	Low	Middle	High
	Reading			
Center Care	0.895*** (0.244)	0.311 (0.535)	0.934*** (0.325)	0.835 (0.594)
15-30 hours/week, 9 months	0.812*** (0.264)	0.338 (0.692)	0.654* (0.390)	1.072** (0.428)
At least 30 hours/week, 9 months	0.898*** (0.244)	1.562*** (0.590)	1.373*** (0.352)	-0.192 (0.430)
Observations	11293	2439	5784	3070
R-squared	0.35	0.27	0.29	0.31
	Math			
Center Care	0.938*** (0.232)	0.970* (0.534)	0.859*** (0.309)	0.894 (0.549)
15-30 hours/week, 9 months	0.745*** (0.251)	-0.201 (0.691)	0.542 (0.370)	1.265*** (0.395)
At least 30 hours/week, 9 months	0.807*** (0.232)	1.152* (0.590)	1.055*** (0.335)	0.319 (0.398)
Observations	11293	2439	5784	3070
R-squared	0.36	0.30	0.29	0.30
	Behavior			
Center Care	-0.009 (0.028)	-0.128* (0.066)	0.050 (0.037)	-0.118* (0.069)
15-30 hours/week, 9 months	-0.109*** (0.031)	-0.022 (0.085)	-0.112** (0.044)	-0.128*** (0.049)
At least 30 hours/week, 9 months	-0.252*** (0.028)	-0.045 (0.073)	-0.265*** (0.040)	-0.312*** (0.050)
Observations	11293	2439	5784	3070
R-squared	0.14	0.17	0.14	0.15

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%
 Models include child/family and zip code level controls, as well as Head Start dummy and non-relative care dummy (excluded group is parental care). Poor, middle, and high income models include a continuous income to needs variable.

Appendix Table 1: Control Variables from ECLS-K

Variable	Description
Child age	Child's Age at Assessment
Child gender	Dummy Variable
Birth weight	In ounces
Child weight	Average of two interviewer assessed measurements in lbs.
Child height	Average of two interviewer assessed measurements in inches.
Race/ethnicity	4 dummy variables for black, Hispanic, Native American, and Asian
# of children	Dummy variables ranging from 1 to 11 for the number of children in household
Family structure	3 dummy variables: Single parent (one biological parent), blended family (one biological and one non-biological parent), adopted or foster parents
Urbanicity	Locality is city or town (2 dummy variables).
Region	North, South, Midwest (3 dummy variables).
Mother's employment	Dummy variable for whether the mother was ever employed between child's birth and entry into kindergarten?
Parents' education	Six dummy variables for father's and mother's education: Less than high school degree through advanced post-graduate degree
English	Dummy variable for whether English is the only language spoken in home .
Parents' current employment	Full-time (35 or more hours per week), part-time work (fewer than 35 hours per week), or no work (2 dummy variables for each parent).
WIC	Dummy for whether mother or child ever participated in Women, Infants and Children nutritional supplement program.
income-to-needs	Household income vs. federal poverty level ratio (9 dummy variables).
Expectations	Parental Expectations for Child's education (4 dummy variables)
Importance of skills	Importance of skills: counting, sharing, communication, drawing, knowledge of letters on scale of 1-5.
Choice of location	Parents chose home location for current school (dummy variable).
Home learning activities	Frequency of 7 activities: building things, teaching about nature, playing sports, doing art, doing chores, singing songs, playing games. 7 variables scaled from 1-4.
# of children's books in home	Ordinal variable. Ranges from 0 to 200.
# of music tapes, CDs, or records in home	Ordinal variable. Ranges from 0 to 100.
Reading	Frequency of child looking at picture books or reading outside of school (2 variables).
School activities	Attendance since beginning of school year at PTA meetings, open houses, parent groups, parent advisory meetings; volunteered at school, participated in school fundraiser (6 dummy variables).
Parenting stress and depression	Two continuous variables (averages of 8 and 12 items). Higher score composites indicate more stress, depression.
Spanking	Dummy, 1 if parent spanked child in last week.
Eating Habits.	Days per week family usually eats meals together, at regular time (4 dummy variables)
Computer.	Dummy variable if family has a computer.
T.V	Number of hours child watches TV on weekdays.
Visiting	In the past month, have you visited a zoo, library, museum, concert (4 variables)
Other non-school activities	Child has ever taken lessons or participated in performing arts or organized clubs outside of school (7 dummy variables).
Neighborhood	Mean of 6 items asking about neighborhood problems.

Appendix Table 2: Zip Code Level Data from the 2000 Long Form of the Decennial Census

Variable	Variable
Total Population	% Black
% Urban	% Native
% 5 and under	% Pacific
% of children under 5 in poverty	% Other
% of population over 16 in the labor force who are unemployed	% Mixed
% of children 0-6 living with single mothers	% Asian
% of children 0-6 living with single fathers	% Hispanic
% of women with children 0-6, in the labor force, unemployed	% of households in which Spanish is sometimes or always spoken
% of women over 25 with less than a hs diploma	% of households in which a language other than English is sometimes or always
% of women over 25 with a hs diploma or equivalency	% of households that are linguistically isolated (no one over 14 speaks English)
% of women over 25 with a BA or more	% of family households with 6 or more members
estimated pct of 3 and 4 year olds in preschool/nursery school	% of population who is non-citizen
estimated pct of 3 and 4 year olds in PUB preschool/nursery school	

Appendix Table 3: Statistical Matching Estimates of the Effects of Child Care Settings on Cognitive and Behavioral Outcomes

	Statistical Matching Results - Head Start Children Excluded		
	Low Income		
	Reading	Math	Behavior
Center Care (n=2121)	0.915**	1.450***	-0.104**
	(0.358)	(0.358)	(0.043)
R-squared	0.31	0.34	0.20
	Middle Income		
	Reading	Math	Behavior
Center Care (n=5642)	1.283***	1.070***	-0.068***
	(0.219)	(0.208)	(0.018)
R-squared	0.30	0.29	0.14
	High Income		
	Reading	Math	Behavior
Center Care (n=3000)	1.159***	1.194***	-0.222***
	(0.306)	(0.279)	(0.034)
R-squared	0.34	0.32	0.17