TECHNICAL REPORT

How Much is Too Much?

The Influence of Preschool Centers on Children's Development Nationwide

Susanna Loeb
Margaret Bridges
Daphna Bassok
Bruce Fuller
Russ Rumberger

Stanford University
University of California

Presentation at the Association for Policy Analysis and Management
Washington, D.C. – November 4, 2005

This paper has undergone peer review and will appear in
Economics of Education Review

1. Backdrop – The Varying Effects of Preschool Centers on Different Children

Young children benefit from exposure to preschool or child-care centers, at least among those from poor families and within the domains of cognitive growth and school readiness. Carefully controlled experiments, exemplified by the Perry Preschool or the Abecedarian Project, have long shown sustained effects on cognitive growth for children from poor Black families (Campbell, Ramey, Pungello, Miller-Johnson, & Sparling, 2002). Even beyond these so-called "boutique programs," larger public initiatives, such as the Chicago Child-Parent Centers, show encouraging results, as do center programs of naturally varying quality spread across different states (Loeb, Fuller, Kagan, & Carrol, 2004; Reynolds & Temple, 1998).

What we don't know is whether the effects of preschool centers vary by intensity of exposure and for children from different backgrounds. Little is known, for instance, about whether middle-class children experience the same bump in early learning when they attend a center program, comparable with the gains displayed by poor children.

This analysis extends recent work by Magnuson, Ruhm, & Waldfogel (2004) to consider the effects of different preschool or child-care arrangements on children's cognitive and social proficiencies at the start of kindergarten, focusing on how the *duration* and *intensity* of participation affect children across developmental domains. And we focus on how such benefits or decrements in development may vary across children from different social classes and ethnic groups. These issues are directly germane to debates over whether extending free preschool to all children is a cost-effective policy strategy, whether full or half-day programs are advisable, and which groups of children would likely benefit at what level of magnitude.

Our analyses, drawing on data from the Early Childhood Longitudinal Study (ELCS), starts by asking the question: Does exposure to a preschool center in the year(s) before kindergarten advance children's cognitive and social development?

Next we ask how the relationships between center exposure and child development may vary for diverse groups of youngsters who come from different income and ethnic groups.

Finally, we focus on the effects of the intensity and duration of center attendance – as measured in years, months per year, and hours per week – on child outcomes. Never before has the field been able to test these relationships with a large, nationally representative sample of young children with such rich background data on their families and *a priori* parental practices.

Which Children Benefit from Exposure to Preschool Centers?

Almost two-thirds of all four-year-olds now attend center programs before starting kindergarten (U.S. Department of Education, 2003), although the length and intensity of their exposure and the quality of these local programs vary dramatically. Exposure to these diverse organizations, often called preschools or center-based programs, benefits children's cognitive development, and appears to be one of the most effective interventions for advancing poor children's learning (Heckman, 2000; Shonkoff & Phillips, 2000). The cognitive benefits appear to be modest to strong for some groups. But researchers estimating effects on children's social-behavioral outcomes also have detected negative effects for children, at least in local or large yet unrepresentative samples of children (e.g., Belsky, 2001; NICHD ECCRN & Duncan, 2003).

Disparities in early cognitive proficiencies are starkly evident across social class and ethnic groups as children enter kindergarten (Jencks & Phillips, 1998; Reardon, 2003; Rumberger and Arellano, 2003). The difference between Black and White children, for example, 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 Hispanic five-year-olds in California score about 0.38 of a standard deviation (*SD*), or about three months, behind White youngsters in pre-reading and math skills (Rumberger and Arellano, 2003).

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

Would Wider Access to Preschool Centers Narrow Gaps in Early Development?

Attending high-quality centers appears to boost some 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 – including centers, Head Start preschools, licensed homes, or individual caregivers – to determine which might hold the most promise for improving children's cognitive and social-behavioral outcomes.

Center programs appear to offer the most benefits for poor children in terms of cognitive gains and advances in school readiness (Loeb, Fuller, Kagan, & Carrol, 2004). Children's participation in carefully controlled and expensive "boutique" preschools has shown immediate and long-term benefits (Barnett, 1995; Campbell & Ramey, 1995). Head Start, distinguished by the especially poor children it serves and centralized quality

regulations, also improves children's outcomes, though findings vary across different groups of children (Currie & Thomas, 2000; Garces, Thomas, & Currie, 2002).

If exposure to center programs boosts poor children's development, this intervention strategy could help to close the achievement disparity. Yet this leads to the empirical question of whether or not the effects of center exposure vary across social-class and ethnic groups. Two papers from Magnuson and her colleagues have recently showed that exposure to center-based programs appears to raise cognitive proficiencies for middle-class children as well as for children from low-income families (Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Magnuson, Ruhm, & Waldfogel, 2004). An analysis for the California sub-sample of the ECLS data also found significantly higher cognitive proficiency levels for English-proficient Hispanic children from middle-class homes when they had attended center programs in the year before kindergarten (Bridges, Fuller, Rumberger, & Tran, 2002).

Several studies indicate that children from disadvantaged homes experience gains of larger magnitude, stemming from exposure to preschool centers, compared with the degree of benefits exhibited by children from middle-class families (Burchinal, Campbell, Bryant, Wasik, & Ramey, 1997; Campbell & Ramey, 1994; Magnuson, Ruhm, & Waldfogel, 2004). Center programs also may benefit English-language learners differentially, given that these children are less likely than others to experience the types of early literacy practices in the home which have been found to facilitate early language and cognitive development (August & Hakuta, 1999; Snow, Burns, & Griffin, 1998).

Differing rates of access to center programs continue to worry policy makers and hold implications for taking into account prior selection processes when estimating effects of centers on child development. Participation rates in centers programs rise with social class: children from affluent families are much more likely to enroll than children from other SES groups (O'Brien-Strain, Moye, & Sonenstein, 2003). More than 70 percent of upper middle-class children attend center-based programs before starting kindergarten, compared with 45 percent of those from low-income families (Hofferth, Shauman, Heake & West, 1995).

The expansion of Head Start and state preschools has dramatically increased participation by children from poor families since the 1960s (Smith, Kleiner, Parsad, Farris, & Green, 2003). In fact, many working-class families have less access to centers than their poor counterparts, since they lay just above income eligibility cutoffs for subsidies yet cannot afford high fees (Fuller, Loeb, Strath, & Carrol, 2004; Fuller, Livas, & Bridges, 2005).

In addition, ethnic disparities in preschool access remain stark. Hispanic parents enroll their children in centers at a rate 23 percentage points below the enrollment rate for Black children, and 11 percent below Whites, even after taking into account maternal employment status (Liang, Fuller & Singer, 2000). Asian American children participate in preschool at substantially lower rates than do Whites or Blacks, while showing quite high pre-reading and math proficiencies as they enter kindergarten (NCES, 1998).

Does Intense Exposure to Preschool Centers Advance or Constrain Early Development?

A major concern for parents and now policy makers is the question of how much time children should spend in preschool or other child-care programs. Yet little empirical work has focused on the effects of the length of exposure to center programs for toddlers and preschoolers, nor on the intensity of exposure in terms of hours per day. The effects of different child care arrangements are likely based in part on the amount of time children are exposed to them. Exposure can be seen 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, or guards against detrimental social-behavioral effects, for children.

Research to date generally shows that earlier intervention is best, at least for children from poor families (Shonkoff & Phillips, 2000). Preschool may be atypical, however, as it entails separation from parents while exposing children to quite variable, more formal learning environments. The evidence on the effects of early entry into child care is mixed. Entering center-based care in infancy may not be a detriment to poor children's cognitive outcomes (Vandell & Ramanan, 1992); in contrast, it may have negative effects on the cognitive skills of White or middle-class children (Han, Waldfogel, & Brooks-Gunn, 2001; NICHD ECCRN, 2002).

Later entry appears to diminish these potential negative effects on cognitive development and in fact provide benefits. Initial work with the California sub-sample of the ECLS-K data indicates that starting center-based care at age three provides a boost to children's early reading and math skills, in comparison to starting later (Bridges, Fuller, Rumberger, & Tran, 2004). Clements, Reynolds, & Hickey, (2004) confirmed this finding for children attending Chicago Child-Parent Centers (CPCs), with two years of preschool—starting at three—providing more benefits to children at school entry than just one year, although these increases were no longer significant in first grade.

In contrast, entering preschool centers – especially for many hours each day – may hold negative social-developmental outcomes for children, including disruptive and more aggressive behavior in centers and later in school (Belsky, 2002; Han, Waldfogel, & Brooks-Gunn, 2001). These negative effects on children's social behaviors also have been observed for children who begin center programs later (at age four) and may be associated with the cumulative amount of time spent in child care, rather than the age of initial entry (Colwell, Pettit, Meece, Bates, & Dodge, 2001).

For example, children spending long hours or more months in center care each year exhibit greater problem behaviors, including elevated levels of aggression and less effective impulse control, compared with children attending fewer hours each day (Bates, Marvinney, Kelly, Dodge, Bennett, & Pettit, 1994; Belsky, 2001; NICHD ECCRN, 2003). Belsky, using

the largely middle-class NICHD sample, found a linear relationship between the number of hours spent in child care and externalizing behavior. That is, the more hours children spent in center programs, the more externalizing behavior they exhibited (Belsky, 2002).

Han, Waldfogel, and Brooks-Gunn (2001) examined related questions about time in child care and behavior problems with another large national data set, the National Longitudinal Survey of Youth (NLSY). They found that White children whose mothers worked within the first nine months of their lives, and thus presumably attending non-maternal care, displayed higher rates of externalizing behaviors by age seven or eight. Given that this association is between maternal employment – not child care per se – and children's elevated levels of externalizing, it may be the long separation from parents and not necessarily child-care exposure that act to increase children's risk for behavior problems.

While this evidence suggests that time spent in center programs may increase behavioral problems (NICHD ECCRN, 2003), it is not clear that these effects are seen across children from different backgrounds. Clements, Reynolds, & Hickey (2004) found positive effects on the social-emotional and behavioral outcomes of children in the Chicago CPC program, which entailed children's participation of about 15 hours per week. The benefits were significant and sustained over time: participating youngsters displayed better behavioral outcomes in school and lower rates of delinquency and criminal behavior years later. While these results are encouraging, this intervention was conducted with very poor children and offered far more comprehensive family services than standard preschools, including a home-visiting component and intensive parent involvement.

The present study contributes to this literature in several ways. In addition to using a nationally representative sample of children who showed at least minimal levels of English proficiency (for the pre-reading assessment), we assess the duration effect of center programs by asking, what is the optimal age for children to enter center programs? Second, we look at the possible effect stemming from more intense exposure each week , asking whether there is some number of hours per week of attendance that holds an optimal effect. Third, we examine both these effects by the income of the child's family and by ethnic groups, 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 debate over universal preschool. In addition, we run numerous specification checks, including an instrumental variables analysis and propensity score matching to reduce potential selection bias.

2. A Nationwide and Representative Sample of Kindergartners

Our analysis utilizes data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS), collected by the National Center for Educational Statistics (NCES). These data were drawn from interviews with a nationally representative sample of parents with young children, along with direct assessments of their five year-olds and interviews with kindergarten teachers. We analyzed data for 14,162 children who entered kindergarten for

the first time in 1998. We excluded children with missing scores on any of the assessments and children with no child care information.[1]

Preschool center and child care types. In the fall of kindergarten, parents were asked a series of questions regarding their child's care arrangements since birth, including the main kind of care or early education utilized in the year immediately prior to kindergarten. Based on their responses, we separated children into four mutually exclusive *child-care types*: (non-Head Start) center program, Head Start program, parental care, and nonparental care. The nonparental care group includes care by non-parent relatives and non-relatives such as a babysitter. Though parents were asked to specify whether their child attended 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.

Thus we 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 and a Head Start program, we placed her in the group in which she spent more hours per week.[2]

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 at first entry to center care (age 0-1, 1-2, 2-3, 3-4, 4-5, greater than 5, and unknown).[3] We also created two intensity variables: the first dichotomous (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 sets the

[1] The full ECLS sample includes 21,260 children. We dropped students who were missing child care information (3,190), children who were not first-time kindergarteners (867), or missing any one assessment (3,041). The remaining sample included 14,162 children. For the analyses we only include children who have valid responses on all variables. We ran specification checks with missing values imputed using best-subset regression and found no meaningful difference in the statistical significance or magnitude of the estimates of interest.

[2] If center hours and Head Start hours were equal, we considered the child a Head Start attendee. We were also concerned that parents might misreport Head Start attendance; however, NCES independently confirmed Head Start attendance. We assigned to the center care group those who reported attending Head Start but were not confirmed as attending Head Start. Because we assumed that unverified Head Start attendees actually attended centers, we also assumed that the parent-reported age at Head Start entry as well as the Head Start weekly hours variable actually referred to centers, and recoded them as such.

[3] Parents were asked to indicate their child's age when she or he first entered a particular type of care. It is important to note that age at entry does not necessarily imply continual enrollment. For instance, a child may have entered center care at age two for several months, withdrawn, and entered center care again at age four. The ECLS data do not include parents' reports on the continual, or discontinuous, usage of care.

weekly hours to at least 30 hours per week and at least nine months[4]. Approximately 21% of children who use a center as their primary care type are in the first, *moderate intensity*, group, and 30% in the *high intensity* group. While we created these distinctions in keeping with the typical half-day program and the typical full-day program, this categorization is not the only one worth considering; therefore we ran a number of specification checks with alternative definitions of intensity.

Child development outcomes. NCES field staff, in the fall of kindergarten, conducted one-on-one child assessments to measure 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 abilities (Early Childhood, 1998-99).

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 analyses we used standardized T-scores. These scores are transformations of raw scores that have been rescaled with a mean of 50 and a standard deviation of 10. T-scores are norm-referenced measures of early learning for specific domains and provide an indicator of how each individual child performs relative to the national average.

Beyond assessing the effects of center programs on cognitive outcomes, we examined children's social-behavioral skills and problems as reported by kindergarten teachers for each of their children. 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 motivated engagement of learning activities, 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 (Cronbach's alpha of 0.87). The behavior score is standardized with mean of zero and a standard deviation of 1, so reported coefficients are readily interpretable as effect sizes.

Other predictors and family background control measures. In order for the results to be comparable with Magnuson, Ruhm, & Waldfogel (2004), we use the same set of ECLS variables as controls for family background characteristics. Appendix Table 1 lists these measures. In order to capture neighborhood effects, we also include a set of zip code level variables, aggregated from the long form of the 2000 Decennial Census. Appendix Table 2 lists these variables which capture variable attributes of the communities in which ECLS families reside.

Table 1 gives the means and standard deviations of a subset of the variables for the full child and family sample and separately for youngsters attending each type of child care. We

[4] The majority of children who attended a center for more than 15 hours a week also attended for 9 months per year or more (78%).

see that 64 percent of all children attended a center program nationwide, 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 South and much more likely to be Black. Center programs are 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 attending a Head Start preschool, not surprisingly, had experienced lower birth weight, were more likely live in a single-parent family, have parents without high school degrees, have participated in WIC, compared with all other children in the ECLS sample. Parents who provided the sole care for their children were, not surprisingly, less likely to be single parents and less likely to work full time. Children in center programs were more likely to speak English at home and have more highly educated parents. Children with other non-parental care were more likely to come from families in which the mother works full time.

In addition to these differences in social status, children vary in their home lives when split by the type of preschool or child care they enter. For example, children in Head Start benefited from the fewest count of books in their home, while those in other centers have the most. Children in Head Start watch the most television, while those in other center programs watch the least. Children attending Head Start are most likely to be spanked, while those in center programs 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 programs are most likely.

3. Analytic Plan and Methodology

These prior differences in family background must be taken into account as we estimate the discrete effects of exposure to center program on children's social and cognitive development at the start of kindergarten. 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. The following equation summarizes this analytic approach:

$$Y_{izs} = \alpha_0 + C_{izs}\alpha_1 + X_{izx}\alpha_2 + Z_{zs}\alpha_3 + \pi_s + \varepsilon_{izs}$$

The outcome (Y) of child (i) in zip code (z) and state (s) is a function of child care type (C), child and family characteristics (X), demographic attributes of the zip code in which the child resides (Z), state fixed effects (□), and a random and normally distributed error term (□).[5] 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.

[5] Most analyses using ECLS require clustering by school for properly estimating standard error. However, because child care attendance occurred prior to schooling, clustering is unnecessary in this case. Specification checks using clustering at the school level show no difference in the statistical significance of estimated effects.

The center program 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.

While we include many measures of family background as controls in the analyses, it is easy to miss-specify a regression model. For example, many regression models assume 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 points that fall mostly within 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. In addition we run a separate analysis 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).[6]

Analyses that assess treatment effects with non-experimental data are often subject to omitted variables bias. We reduce this possibility in our analyses by using an unusually rich set of control variables as discussed above. We also attempted an instrumental variables estimation, based on measures of child care supply, with the hypothesis that supply factors would influence parents' selection of child care but be unrelated to other aspects of family background that would directly affect child outcomes. 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 in the second stage, we posited that these measures would predict center use but not child outcomes. Due to our concern that child care establishments could act as a proxy for unmeasured tastes, we also ran specifications that did not include this measure.

To supplement these zip code level measures, we 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 programs, Head

[6] 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.

Start, and the child care component of their Temporary Assistance to Needy Families (TANF) initiative was divided by the number of children under five years of age living in poverty.[7] Finally, we included measures for the income cutoff for state child care assistance both as a level and as a percentage of the state median.[8] These variables were meant to capture each state's commitment to child care provision, particularly for poor children. We estimated a linear probability model in the first stage. Unfortunately, while the difference between the instrumental variables (IV) estimates and the ordinary least-squares (OLS) estimates were not statistically significant and the IV estimates were in the same direction as the OLS estimates, the standard errors were too large to draw any meaningful conclusions from the IV analyses.

We first present the model for our full sample and then show results broken-down by the children's race and family economic status. Our full sample includes all racial groups identified in the ECLS including Whites, Blacks, Hispanics, Asians, Pacific Islanders and American Indians. However, due to limited sample sizes, we only present results for the White, Black and Hispanic sub-samples. It is important to note that reading assessments were only administered to students deemed minimally proficient in English. Students who could not pass an oral proficiency screener in English were not given the full assessment in pre-reading skills. Therefore, our results regarding the pre-reading assessment are only generalizable to those students whose English ability was above a set threshold. The early math understanding assessment and teacher gauges of children's social skills were administered for all youngsters.

We utilize two approaches to define economic status. As a broad measure of economic well-being, we group together children from families in the lowest income-to-needs ratio quartile, the middle half, and the top quartile. We also consider a stricter measure of poverty that includes only those children whose income-to-needs ratio is less than 0.5 or children whose mother *and* father have never completed high school. This group represents about 8 percent of the full sample.

4. Empirical Findings

Table 2 presents a model that predicts child outcomes based on child-care type and the extensive set of prior family attributes, parental practices, zip code-level demographics, and state fixed effects. The results provide evidence that center care improves children's reading and math skills but also increases behavioral problems relative to parental care. For the full sample of children, the center care coefficient for reading suggests that center care

[7] Head Start and state pre-K spending figures are taken from Blank, Schulman, & Ewan (1999). TANF spending data, for 1999, are from http://www.acf.dhhs.gov/programs/ofs/data/tableB_1999.html, provided by the U.S. Department of Health and Human Services. The share of population under five years of age in poverty is taken from long form of the decennial census, compiled in Geolytics (2001).

[8] Data on the 2001 income cutoffs for state child-care assistance comes from Schulman & Blank (2004). For states with eligibility cutoffs that vary among counties, we used the low end of the range. Any estimates of a relationship between cutoffs and child-care selection should be considered as conservative.

attendance increases reading skills by 1.1 points. The standard deviation in reading is 10.0. Thus the point estimate implies a 0.11 standard deviation (*SD*) increase, considered small to modest. The results are very similar for understanding of math concepts. Attending a center program is associated with a 1.2 point (0.12 *SD*) increase in math performance.

The estimates for the social-behavior index show negative effects from exposure to center programs. Center attendance is associated with a 0.089 point decrease in the behavior index. Remember that this index is normalized, so the regression coefficients can be easily interpreted as effect sizes.

The effects associated with attending a Head Start preschool are estimated in Table 2. For the full child sample they are not statistically different from zero for either pre-reading or math skills, al though they do suggest a negative effect on social behavior. Sampled children attending Head Start exhibit behavior that is 0.12 *SD* units below children who remain in parental care. One caution about the Head Start effects is that of omitted variable bias. Because the negative Head Start effects drop significantly as additional controls are included in the model, we suspect that we may have not fully accounted for the Head Start selection process and that additional controls are needed to adequately estimate these effects.

Many studies have postulated that the effects of center programs will differ across diverse groups of families. For example, children in households with many resources for advancing early language, pre-reading, and math skills may not benefit as much from center care as those in families without such resources. To examine whether child care choices have differing impacts for families based on their income, we also estimated our model for children from families in the lowest income-to-needs ratio quartile, the middle half and the top quartile. We see little difference across these three income groups.

With few exceptions, center programs appear to advance pre-reading and math concepts while under cutting social behavior. The magnitudes of the estimates do vary, with children from middle-income homes experiencing the biggest gains in pre-reading skills. However, the relative magnitude of the effects for low income children is sensitive to the definition of the low-income group. When we use a more restrictive definition of poverty, that is, an income-to-needs ratio of less than 0.5 or very low parental education, we find that the poorest children in the sample enjoy the greatest academic returns to attending center programs.

We employed both instrumental variables and propensity score matching to test the specification of the models as discussed above. Table 3 shows that our instruments were not strong enough to accurately estimate child care effects. While the point estimates are larger, the standard errors are as well. However, the statistical matching results are quite similar to those discussed above. Center attendance is associated with a 0.13 SD increase in pre-reading and math performance and, again, a decrease in the social-behavior index. We also ran the model for each of the three income groups using weights from propensity-score

matching. The results were 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.

One minor difference is that the results are slightly different for pre-reading among children in the high-income group, along with the middle-income behavior relative to social behavior, but this is solely due 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. The propensity score estimates consistently produce smaller standard errors than the OLS estimates, strengthening our confidence in the results.

In Table 4 we present results separately for White, Black and Hispanic children. While the estimates are similar in direction to the results presented above for the entire sample, the magnitude of academic gains are dramatically larger for Hispanic students. For instance, center care is associated with a 0.23 *SD* increase in the reading scores of Hispanic students, almost three times the effect size for White children. This effect size is quite similar to the learning gains observed after Tennessee lowered class sizes to 15-18 students in kindergarten and the early grades. At the same time, center programs do not have a significantly negative impact on the social behavior of Hispanic children. In addition, Hispanic children who attend Head Start do better in reading than those who receive maternal care, though the Head Start effect is smaller then the center effect.

Next we move to the effects associated with duration and intensity with which children are exposed to center programs. 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. Yet except for those who entered after age five, attending a center remains associated with higher scores than parental care. The results for social behavior are different, although perhaps predictable. The negative behavioral effects are greater the earlier a child enters.

These estimations aim to gauge causal effects from exposure to center programs. However, the possibility exists that we have not controlled for some factor that affects both the age of entry and child development. The unusually rich set of controls minimizes this concern. In addition, the difference in the relationship between center duration and achievement in comparison to center duration and behavior suggests that the results are not driven solely by a simple story of selection bias. 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 highest scores across all three measures for children associated with the duration of center attendance. This is not the case. In fact, the social-behavioral effects differ from the cognitive effects.

The middle three columns of Table 5 give the results separately for the lowest quartile, middle half and highest quartile of families' income-to-needs ratio. Again the results are similar across the income groups. Almost uniformly, 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. With only a few exceptions, the pattern that is evident across income groups also holds for Whites, Blacks and Hispanics.[9] One notable exception is that starting a center program early does not seem to have any negative impact on Hispanic children.

The duration – linked to the child's age when first entering a center program – is one dimension for measuring the amount of care received between birth and the start of kindergarten. However, children differ meaningfully in how much time they spend in center care during a given year. Table 6 focuses on 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, or more 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 intensity – attending at least 15 hours per week – substantially increases the contribution of center programs to cognitive growth. Attending for more than 30 hours a week is also associated with positive cognitive skills. And consistent with previous research, we find that long hours are associated with negative behavioral outcomes. 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, more than doubles this negative effect. They move from an effect size of -0.10 *SD* to -0.25 *SD* for the full sample. For children from middle-class and affluent families these decrements equal -0.28 *SD* and -0.29 *SD*. This approximates abut two-thirds the suppressing effect experienced by children who grow-up with a moderately depressed mother.

The estimates for the full child sample obscure important differences observed across different income groups. For the low-income group, only children who attend a center program for more than 30 hours experience significant gains in pre-reading skills. And this same group experiences no negative social-behavioral effects from additional hours in a center. At the other extreme, children from higher-income families do not show any significant gains from attending centers for more than 30 hours per week. In sharp contrast to the low-income children, those from higher income families display increasingly negative behavior the longer they attend a center program each week..

The impact of intensive exposure to a center program also varies dramatically based on the child's race, as shown in Table 7. For example, White children who attend a center

[9] These detailed results are available from the authors (sloeb@stanford.edu).

program for 15-30 hours a week for at least 9 months a year show higher cognitive gains than children who have more limited exposure to a center program. In contrast, Hispanic children do not seem to gain from extra hours at their centers. In fact, more intensive exposure is associated at times with a drop in pre-reading and math performance for Hispanic children.

The results for Black children are more mixed. High intensity center attendance is associated with increased pre-reading scores for Black children, but does not appear to be related to their math performance. Intense exposure to a center is negatively associated with White children's behavior, but interestingly has no discernable effect for Black or Hispanic children. It's important to remember that our results for Hispanic youngsters are only generalizable to those children with minimal proficiency in English. Further research would be useful in assessing whether these effects also hold for Hispanic children with more limited English.

We choose the categories of hours in Tables 6 and 7 to correspond with half-day and full-day center-based programs. Other ways of sorting children into the weekly hours of attendance could be employed. Figure 1 illustrates the distribution of hours of care among children who mainly used center programs. It shows two peaks, one at approximately 10 hours and one at approximately 40 hours. Based on this distribution, we re-ran the model with alternative classifications (for example, less than 20 hours, 20 to 40 hours, and greater than 40 hours) and obtained very similar estimates to those reported in Tables 6 and 7.

Finally, while the models reported combine months with hours, we also ran specifications with these separated. Table 8 shows that additional hours hold a positive effect on cognitive outcomes when they are combined with extended months in centers. More over, additional months do not appear to have a detrimental affect on behavior, instead it is the long hours of attendance each week that appears to drive the decrements in social behavior.

5. Conclusions and Policy Implications

This study began with the question, How much might be too much when it comes to children's attendance at preschool centers? Our findings show that the empirical answer depends upon which domain of child development is being examined. We found that average exposure to a center program before starting kindergarten is associated with about a 0.10 *SD* advantage in pre-reading and math skills. But attending a center also appears to suppress social development, including the child's motivated engagement in kindergarten classrooms, self-regulation, and a variety of interpersonal skills, as reported by their teachers. These differing effects suggest that further research is needed to understand how time is spent during long hours inside centers and the overall quality of average programs.

Are there optimal ages for children to enter center programs, or amounts of exposure that are better, in order to maximize the positive cognitive effects while minimizing negative

social effects? We found consistent effects for the duration of center attendance across income groups. The strongest cognitive benefits were enjoyed by youngsters who entered a center between two and three years of age. Children who started earlier did not display greater pre-reading or math skills, and, in fact, the predicted averages are somewhat lower than for those who started between the ages of two and three years-old.

In addition, the negative behavioral effects associated with center attendance, compared with parental care at home, are much greater for those who enter a center when younger 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 a center program before the age of two is not particularly beneficial for cognitive development and appears to be detrimental for social development. One caveat to these findings is that the ECLS data only provide information on when the child started a center, not a complete child-care history. So, start date serves as a proxy for duration in our analysis.

Our results for the intensity of attending a center program – measured in hours per week and months per year – are worrisome, while varying across different types of families and children.[10] For children from low-income families, additional hours per week are associated with some gains in reading and math and display few detrimental effects on social development. But while high income children enjoy gains in pre-reading and math skills when attending centers at moderate levels of intensity (15 to 30 hours per week), they see no cognitive gains and substantially greater behavioral problems associated with additional hours of attendance.

We also discovered variation in the effects for children of different ethnic groups. Hispanic children appear to benefit more in terms of cognitive development from center attendance than White or Black children with similar characteristics, and Hispanic children's center exposure yields no damaging effect on their social-behavioral growth.

Assessing the cost-benefit of universal preschool or other center programs is well beyond the scope of this analysis. Yet we do find that exposure to at least a half-day center program yields cognitive benefits for most children. Half day programs appear to yield sufficient cognitive gains for children from higher income families, while full day programs better serve children from lower income families, allowing them to gain pre-reading and math skills without any decrement in their development of social skills. This is particular true for Hispanic children.

Overall, the good news is that middle-class children appear to benefit cognitively from exposure to preschool centers. The bad news is that universal access would not likely close early learning gaps. The magnitude of gains for poor children is simply insufficient to catch-up. Instead, extending free preschool to all children – perhaps a well-intentioned goal –

[10] Note that this analysis assesses the effects of hours of attendance within a center program, not total hours of non-parental care. In estimates not presented in this paper, we did not find a statistically significant relationship between total hours of child care, of all types, and child outcomes.

threatens to simply reinforce disparities in early learning until resources are more carefully targeted on low-income communities.

Finally, our findings suggest that greater benefits can accrue from preschool efforts that enroll children before they reach age four. Generally speaking, children learn more when they start between two and three years of age.

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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: No. 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)
Parents at School:					
PTA meeting	0.34	0.36	0.35	0.30	0.27
Parent-Teacher 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 by Income (Full population, Lowest quartile, middle half and upper quartile)

	All	*Low*	*Middle*	*High*	*Very Low*
	Reading				
Center Care	1.116***	0.620	1.272***	0.806	2.015***
	(0.224)	(0.432)	(0.304)	(0.586)	(0.770)
Head Start Care	-0.413	-0.821	0.120	-3.917*	0.367
	(0.351)	(0.504)	(0.589)	(2.059)	(0.848)
Other Non-Parent Care	-0.414	-0.316	-0.280	-0.882	-0.970
	(0.300)	(0.585)	(0.407)	(0.765)	(1.169)
Observations	11577	2670	5891	3016	829
R-squared	0.36	0.28	0.30	0.33	.32
	Math				
Center Care	1.196***	1.188***	1.182***	1.011*	2.191***
	(0.215)	(0.442)	(0.289)	(0.544)	(0.799)
Head Start Care	0.322	0.514	0.097	-0.434	1.138
	(0.336)	(0.515)	(0.560)	(1.911)	(0.880)
Other Non-Parent Care	0.174	0.231	0.410	-0.495	0.045
	(0.288)	(0.598)	(0.387)	(0.710)	(1.213)
Observations	11577	2670	5891	3016	829
R-squared	0.37	0.29	0.30	0.32	.31
	Behavior				
Center Care	-0.089***	-0.158***	-0.014	-0.176**	-0.238**
	(0.026)	(0.054)	(0.035)	(0.068)	(0.096)
Head Start Care	-0.122***	-0.103	-0.141**	-0.414*	-0.158
	(0.041)	(0.062)	(0.067)	(0.240)	(0.105)
Other Non-Parent Care	0.105***	-0.027	0.166***	0.080	-0.224
	(0.035)	(0.072)	(0.047)	(0.089)	(0.145)
Observations	11577	2670	5891	3016	829
R-squared	0.14	0.18	0.14	0.15	.27

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 Children's Cognitive and Social Outcomes

	Instrumental Variables Results		
	Reading	**Math**	**Behavior**
Center Care	11.001**	8.893*	-0.724
	(5.191)	(4.792)	(0.570)
Head Start Care	-1.388	-0.702	-1.417**
	(6.374)	(5.883)	(0.700)
Other Non-Parent Care	6.714	5.693	-0.476
	(4.265)	(3.936)	(0.468)
R-squared (n=9490)	0.21	0.27	0.04
	Statistical Matching Results		
	Head Start Children Excluded		
	Reading	**Math**	**Behavior**
Center Care (n=10763)	1.289***	1.255***	-0.134***
	(0.157)	(0.148)	(0.018)
R-squared	0.34	0.34	0.13
	Center Care Children Excluded		
	Reading	**Math**	**Behavior**
Head Start (n=3992)	-.453*	0.257	-0.155***
	(0.234)	(0.234)	(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: OLS Estimates of the Effects of Child-Care Settings on Cognitive and Behavioral Outcomes, by RACE

	ALL	*White*	*Black*	*Hispanic*
	Reading			
Center Care	1.116***	0.852***	1.026	2.289***
	(0.224)	(0.276)	(0.694)	(0.653)
Head Start Care	-0.413	-0.491	-1.175	1.553*
	(0.351)	(0.546)	(0.806)	(0.884)
Other Non-Parent Care	-0.414	-0.553	-0.687	1.195
	(0.300)	(0.377)	(0.918)	(0.828)
Observations	11577	7495	1549	1456
R-squared	0.36	0.33	0.39	0.39
	Math			
Center Care	1.196***	1.043***	1.602**	1.996***
	(0.215)	(0.269)	(0.645)	(0.603)
Head Start Care	0.322	0.703	0.173	0.974
	(0.336)	(0.532)	(0.750)	(0.816)
Other Non-Parent Care	0.174	0.067	-0.133	1.302*
	(0.288)	(0.368)	(0.854)	(0.764)
Observations	11577	7495	1549	1456
R-squared	0.37	0.33	0.37	0.37
	Behavior			
Center Care	-0.089***	-0.072**	-0.257***	-0.081
	(0.026)	(0.032)	(0.088)	(0.070)
Head Start Care	-0.122***	-0.241***	-0.216**	0.028
	(0.041)	(0.064)	(0.102)	(0.094)
Other Non-Parent Care	0.105***	0.119***	-0.062	0.132
	(0.035)	(0.044)	(0.116)	(0.088)
Observations	11577	7495	1549	1456
R-squared	0.14	0.15	0.18	0.23

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

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

	All (11577)	Low (2670)	Middle (5891)	High (3061)
	Reading			
Started Center Age 0-1	0.999***	0.473	1.351**	0.242
	(0.374)	(0.965)	(0.534)	(0.752)
Started Center Age 1-2	1.306***	1.161	1.171**	0.552
	(0.415)	(1.023)	(0.589)	(0.820)
Started Center Age 2-3	1.952***	2.111***	1.944***	1.338**
	(0.328)	(0.799)	(0.485)	(0.669)
Started Center Age 3-4	1.324***	-0.009	1.700***	1.001
	(0.260)	(0.555)	(0.359)	(0.619)
Started Center Age 4-5	0.728***	0.710	0.776**	0.296
	(0.260)	(0.509)	(0.351)	(0.681)
Started Center Age >5	0.475	0.244	0.814	-0.370
	(0.557)	(1.164)	(0.737)	(1.323)
R-Squared	0.36	0.28	0.30	0.33
	Math			
Started Center Age 0-1	1.404***	0.303	1.590***	1.214*
	(0.359)	(0.986)	(0.508)	(0.697)
Started Center Age 1-2	1.103***	1.537	1.010*	0.471
	(0.398)	(1.046)	(0.560)	(0.761)
Started Center Age 2-3	1.783***	2.731***	1.658***	1.285**
	(0.315)	(0.817)	(0.461)	(0.621)
Started Center Age 3-4	1.393***	1.126**	1.357***	1.379**
	(0.250)	(0.567)	(0.341)	(0.574)
Started Center Age 4-5	0.851***	1.087**	0.889***	0.157
	(0.250)	(0.520)	(0.334)	(0.632)
Started Center Age >5	0.837	0.280	1.005	0.700
	(0.534)	(1.189)	(0.701)	(1.227)
R-Squared	0.37	0.29	0.30	0.32
	Behavior			
Started Center Age 0-1	-0.287***	-0.372***	-0.159***	-0.388***
	(0.044)	(0.119)	(0.061)	(0.087)
Started Center Age 1-2	-0.209***	-0.203	-0.157**	-0.303***
	(0.048)	(0.127)	(0.067)	(0.095)
Started Center Age 2-3	-0.157***	-0.267***	-0.068	-0.233***
	(0.038)	(0.099)	(0.055)	(0.078)
Started Center Age 3-4	-0.085***	-0.154**	-0.011	-0.157**
	(0.030)	(0.069)	(0.041)	(0.072)
Started Center Age 4-5	-0.026	-0.105*	0.040	-0.073
	(0.030)	(0.063)	(0.040)	(0.079)
Started Center Age >5	-0.059	-0.159	-0.012	-0.056
	(0.065)	(0.144)	(0.084)	(0.154)
R-Squared	0.14	0.18	0.15	0.16

All models include all child and family controls and zip controls as well as dummy variables for Head Start participation, other non-parental care, and unknown center start date. Standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: OLS Estimates of the Effects of Intense Exposure to Center Programs on Cognitive and Social-Behavioral Outcomes

	All *(11558)*	**Low** *(2665)*	**Middle** *(5882)*	**High** *(3011)*
	Reading			
Center Care	0.818***	0.272	0.935***	0.674
	(0.237)	(0.475)	(0.321)	(0.605)
15-30 hours/week, 9 months	0.807***	0.188	0.620	0.977**
	(0.261)	(0.659)	(0.390)	(0.433)
At least 30 hours/week, 9 months	0.854***	1.495***	1.287***	-0.407
	(0.241)	(0.545)	(0.350)	(0.440)
R-squared	0.36	0.28	0.30	0.33
	Math			
Center Care	0.928***	1.073**	0.898***	0.695
	(0.227)	(0.486)	(0.305)	(0.561)
15-30 hours/week, 9 months	0.769***	-0.049	0.467	1.296***
	(0.251)	(0.674)	(0.371)	(0.401)
At least 30 hours/week, 9 months	0.704***	0.794	1.036***	0.165
	(0.231)	(0.557)	(0.333)	(0.408)
R-squared	0.37	0.29	0.30	0.32
	Behavior			
Center Care	-0.020	-0.122**	0.056	-0.088
	(0.028)	(0.059)	(0.037)	(0.070)
15-30 hours/week, 9 months	-0.102***	-0.062	-0.117***	-0.123**
	(0.030)	(0.082)	(0.044)	(0.050)
At least 30 hours/week, 9 months	-0.253***	-0.088	-0.279***	-0.291***
	(0.028)	(0.068)	(0.040)	(0.051)
R-squared	0.15	0.18	0.15	0.16

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Models include child and 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 estimation models include a continuous measure of the income-to-needs variable.

Table 7: OLS Estimates of the Effects of Intense Exposure to Center Programs on Cognitive and Behavioral Outcomes by Race

	All (11558)	**White *(7482)***	**Black *(1548)***	**Hispanic *(1452)***
	Reading			
Center Care	0.818***	0.617**	0.295	2.450***
	(0.237)	(0.288)	(0.758)	(0.728)
15-30 hours/week, 9 months	0.807***	1.157***	0.205	-1.629*
	(0.261)	(0.309)	(0.939)	(0.849)
At least 30 hours/week, 9 months	0.854***	0.430	1.566***	0.897
	(0.241)	(0.304)	(0.606)	(0.822)
R-squared	0.36	0.34	0.39	0.40
	Math			
Center Care	0.928***	0.761***	1.376*	1.970***
	(0.227)	(0.280)	(0.708)	(0.671)
15-30 hours/week, 9 months	0.769***	1.142***	-0.173	-1.112
	(0.251)	(0.300)	(0.876)	(0.783)
At least 30 hours/week, 9 months	0.704***	0.625**	0.553	1.117
	(0.231)	(0.295)	(0.566)	(0.758)
R-squared	0.37	0.33	0.37	0.37
	Behavior			
Center Care	-0.020	-0.007	-0.155	-0.051
	(0.028)	(0.034)	(0.096)	(0.078)
15-30 hours/week, 9 months	-0.102***	-0.119***	-0.169	-0.054
	(0.030)	(0.036)	(0.119)	(0.091)
At least 30 hours/week, 9 months	-0.253***	-0.287***	-0.184**	-0.069
	(0.028)	(0.036)	(0.077)	(0.088)
R-squared	0.15	0.16	0.18	0.23

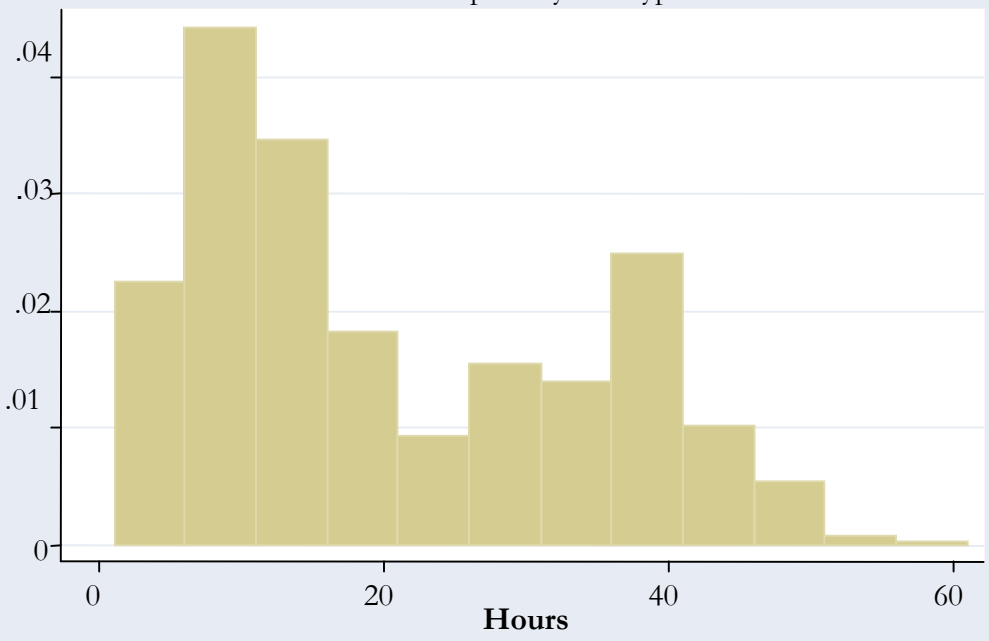
Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All models include child and family and zip-code level controls, as well as Head Start dummy and non-relative care dummy (excluded group is parental care).

Table 8: Alternative OLS Estimates of the Effects of "Intense" Center Care on Cognitive and Behavioral Outcomes for the Full Sample

	READING	MATH	Behavior
center	0.826**	0.666*	0.028
	(0.363)	(0.346)	(0.042)
15-30 hours	-1.216**	-1.198**	-0.149**
	(0.573)	(0.545)	(0.066)
>=30 hours	-0.550	0.323	-0.341***
	(0.555)	(0.528)	(0.064)
nine months or more	0.391	0.557*	0.018
	(0.346)	(0.329)	(0.040)
15-30 hours & nine months or more	1.704***	1.687***	-0.015
	(0.632)	(0.602)	(0.073)
>=30 hours & nine months or more	1.091*	0.183	0.020
	(0.597)	(0.568)	(0.069)
R- squared	0.35	0.36	0.14

Figure 1: Density of Hours in Center Per Week

For children whose primary care type was center.



Appendix Table 1: Control Variables from the ECLS-K data

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 equivilancy	% of households that are linguistically isoloated (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	