do child care centers benefit poor children after school entry?

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ABSTRACT

Attendance in preschool centers can yield short-term benefits for children from poor or middle-class families. Yet debate persists in Europe and the United States over whether centers yield gains of sufficient magnitude to sustain children's cognitive or social advantages as they move through primary school. We report on child care and home environments of 229 children in the US who were 2½ years of age (on average) at entry to the study. Among children attending a center at 2½ or 4½ years of age, cognitive proficiencies were significantly higher at 7½ years of age, compared with children in home-based care, after taking into account prior proficiency levels, maternal attributes, and other covariates. No relationship between center attendance and social development, positive or negative, was detected at 7½. A priori selection factors modestly helped to explain the likelihood that mothers enrolled their child in a center. But associations between center exposure and higher cognitive proficiency at age 7½ remained after controlling for selection factors and testing for omitted variables bias.

KEYWORDS *child care effects, family poverty, maternal practices*

We know that small, high-quality preschool experiments can yield sustained benefits for children from low-income families in terms of early cognitive, linguistic, and social development (e.g. Campbell and Ramey, 1994; Schweinhart

journal of **early childhood research**

Vol 6(3) 211–231 [ISSN 1476-718X DOI: 10.1177/1476718X08094446]

et al., 2005). What remains unclear is whether large-scale public initiatives – such as Head Start in the United States or Sure Start in England – offer benefits of sufficient magnitude to aid children as they move through primary school. The evidence to date, gleaned mainly from the US, is inconsistent and suggests modest effect sizes (Magnuson et al., 2004; NICHD, 2005).

Sharper theoretical accounts have yet to pinpoint the family and organizational conditions under which preschool centers (hereafter, centers) yield sustained benefits. Recent findings, for example, show how effects vary by the class or ethnic characteristics of children, and by the intensity of exposure (Currie and Thomas, 1999; Loeb et al., 2007; NICHD, 2005), and we have much to learn about how quality mechanisms may boost center effects (e.g. NICHD and Duncan, 2003; Peisner-Feinberg et al., 2001).[1]

To assess the magnitude with which center attendance may be associated with children's cognitive or social proficiencies in primary school, we followed a sample of 229 low-income children over a five-year period, from age 2½ to 7½ years. The centers attended were representative of 'garden variety' programs supported with public funds, in contrast to expensive experiments, such as the earlier Perry or Abecedarian programs. We tested for possible benefits of early center attendance and higher quality, and methods were employed to guard against selection bias.

sustained benefits from attending preschool centers?

which children display sustained benefits?

The literature on center effects has advanced in three important ways. First, the field has moved from evaluating small experiments to examining larger public programs of the scale that make findings generalizable and relevant to contemporary policy debates. The Perry Preschool and Abecedarian Project continue to be cited for the sustained effects observed among the small number of African American children who participated in these true experiments (Campbell et al., 2002; Schweinhart and Weikart, 1997). Yet Perry included an intensive parent training component costing about $7,600 per year. The Abecedarian Project cost $34,476 per child annually, two to five times the cost of contemporary publicly funded centers (each in 2000 dollars, Schweinhart et al., 2005).

More recent evaluations of large-scale public programs show persisting effects for children of low-income families on elementary school achievement and well-being into adulthood. Reynolds and Temple (1998), for instance, drew a sample of 1539 kindergarteners in the mid-1980s, assessing the short- and long-term benefits associated with attending one of 25 Child-Parent Centers (CPCs) operated by the Chicago public schools. Even children in the subgroup receiving

the most limited treatment, displayed cognitive gains which persisted to age 14, with effect sizes ranging from 0.21 of a standard deviation (SD) in kindergarten to 0.16 SD in ninth grade (Reynolds et al., 2002).

Oklahoma's universal preschool program also displays positive benefits, at least the Tulsa site which largely serves poor and working-class families. Gormley et al. (2005) drew on a sample of 3149 kindergartners, two-thirds of whom qualified for federal lunch subsidies, compared with children of similar ages who fell on either side of Tulsa's cutoff date for starting kindergarten, allowing for a regression-discontinuity analysis. Center exposure yielded gains (0.79 SD) in children's letter-word identification scores and a 0.38 SD gain for proficiency in applied problems. We don't know whether these benefits will be sustained through primary school.

A second advance in studying center effects stems from nationwide samples of young children who have attended centers for varying lengths of time. This moves from concern over whether earlier results can be generalized to the range of 'garden-variety' centers spread throughout the US funded by government or parental fees. The National Institute of Child Health and Human Development (NICHD) Study of Early Care and Youth Development falls in this genre, sampling a cohort of infants born to English-speaking parents. This research team detailed how the cognitive benefits of greater exposure to child care settings (of variable quality, not exclusively centers) can still be detected at the end of third grade. Yet assessment scores in reading, math, and memory were just 0.07 to 0.09 SD higher when they attended centers, compared with children attending other care arrangements (NICHD, 2005). Eight years after entering the study, less than 10 per cent of the children came from low-income families. Similarly tepid results stem from England's young Sure Start program. The initial national evaluation detected small and inconsistent benefits as children moved into primary school (Schneider et al., 2006).

Another investigation drew from the nationwide Early Childhood Longitudinal Study (ECLS-K, n = 14,162), finding that children from low-income homes who attended a center the year before entering kindergarten had gained 0.20 SD in language and pre-reading skills and 0.22 SD in math concepts by the fall of the kindergarten, compared with similarly low-income children staying at home (Loeb et al., 2007). But effect sizes were smaller, about half the magnitude, for children from middle-class homes.[2]

Third, recent work delineates how persisting center effects can differ across developmental domains. One worrisome finding is that long hours in centers each day appear to slow normal rates of social development for certain subgroups. The NICHD team (2003) found elevated levels of aggression among children, age 4–5 years, when exposed to longer hours of any form of non-parental care, although this largely dissipated by sixth grade (NICHD, 2005; also Belsky et al., 2007).

Loeb et al. (2007) also found a negative association between long hours in centers and children's social behavior, drawing from the ECLS-K data.

persisting questions regarding persisting effects

By following a sample of low-income children over a five-year period, moving through different forms of child care and into primary school, we inform this debate over the persisting effects of attending centers. For example, evidence remains limited on whether cognitive benefits persist into primary school for poor children after they attend a diverse range of center-based programs. Second, the flatter rate of social development observed among children attending centers, at least among low-income white and African American children, continues to surface. Yet non-experimental studies have typically avoided careful estimation of maternal or home attributes that may influence a priori center selection. We gathered data on a range of possible selection factors that may have biased earlier estimates of cognitive or social-developmental effects. Finally, we examined whether the education levels of center teachers or caregivers, along with an environmental rating scale for the child's center or home setting at age 2½ and 4½, were associated with children's cognitive or social proficiency levels in primary school (at age 7½).

Our earlier article detailed strong associations between children's attendance in center programs and cognitive proficiencies over the first two waves of data, from 2½ to 4½ years of age (Loeb et al., 2004). The present analysis aimed to replicate this finding for children participating in all three waves of data collection (after sample attrition). We then ask whether earlier center exposure is associated with higher cognitive or social proficiency levels at the third wave, when the children were about 7½ years of age, after taking into account earlier proficiency levels, maternal attributes, and a priori home factors associated with a greater likelihood of selecting a center.

design and method

participants and procedure

In 1998 we drew a random sample within two California counties of 415 single mothers, as each was entering the new welfare-to-work program (wave 1).[3] This resulted from 473 original contacts with eligible women as they visited local welfare offices (an 88% consenting rate).[4] Each eligible family included at least one child between 12 and 36 months of age (the focal child, mean age 2½ years) at entry to the study. Mothers were interviewed in-person on a variety of topics, detailed below. Follow-up assessments of wave 1 child care settings, whether located within homes or formal centers, were conducted within six months of the first interview.

Field staff conducted phone interviews with mothers again in 2000, and then visited homes to ask about sensitive information and to conduct a direct assessment of the focal child's cognitive proficiencies (wave 2). This procedure was repeated in 2003 (wave 3). A direct assessment of children's cognitive proficiencies was administered at home or school. Each child's homeroom teacher reported on the child's social skills and possible behavior problems. A total of 229 mothers remained in the study through wave 3, or 55 per cent of the original California sample over the five-year period. This level of attrition necessitates comparison of family attributes across the three waves, provided below. Our loss of families is in line with similar studies.[5] Cognitive assessments were completed for 185 children at wave 3, and teacher-reports of social development were successfully collected for 163 children. The median child participant was 2½, 4½, and 7½ years of age at wave 1, 2, and 3, respectively.

Table 1 reports on sample attrition over the five-year span of data collection. The wave 2 column compares family attributes for the wave 2 sample with those of the wave 1 sample. Significance tests pertain to those who exited from the study versus those retained. Slightly younger children were retained at wave 2, as was a greater share of African American families. Mothers without a

table 1 analysis of family sample attrition, wave 1 to wave 3 (1998 to 2003)

	Wave 1, 1998	Wave 2, 2000	Sig.	Wave 3, 2003	Sig.
Mothers's age (in years)	27.8	27.6		28.1	
Focal child's age at first assessment (in months)	28.8	28.0	**	28.4	
Mother's ethnicity					
Percentage, African American	30.6	36.9	**	33.2	
Percentage, Asian American	18.1	5.1	**	14.8	
Percentage, Latina	35.7	42.4	**	35.4	
Percentage non-Latina white	11.1	11.9		12.7	
Education					
Mothers not completing high school or GED (%)	51.3	49.1		45.4	**
Work and earnings					
Mother working at wave 1 (%)	16.7	17.6		20.2	*
Mother's earned income at wave 1 ($ per month)	504	527		489	
Family sample size (*n*), original and over time	415	295		229	
Rate of sample attrition		Wave 1 > 2 29%		Wave 1 > 3 45%	

t-tests compare the wave 2 and wave 3 samples to the lost members of the original wave 1 sample.

** Statistically significant at $p < 0.01$, * significant at $p < 0.05$.

high school diploma tended to leave the study at a higher rate, compared with those who graduated. And mothers who were employed at wave 1 were slightly more likely to still be participating at wave 3.

wave 1 and wave 2 measures (predictors)

maternal and home characteristics

Interviews with mothers at waves 1, 2, and 3 provided a range of data on individual attributes, home conditions, and parenting practices. Demographic variables included mother's age, ethnicity, home language, school attainment, and participation in education programs offered by social welfare agencies or colleges. The mother's mental health was assessed with the Center for Epidemiologic Studies Depression Inventory (CESD) at wave 1 and wave 2 (McDowell and Newell, 1996; Radloff, 1977). We utilized questions from the Home Observation for Measurement of the Environment (HOME) Inventory related to parenting practices, such as the frequency with which the mother read with her child, the count of children's books in the household, and visits to libraries and museums (Bradley, 1993). The reading-frequency variable proved to be the most discriminating over time.

A pair of scales, each containing four interview items, was used to measure the amount of stress present and the quality of social relationships inside the household, as perceived by the mother, adapted from Abidin and Brunner (1995). The first measure includes stress related to material conditions, such as the electricity being shut off and delaying rent payments, as well as verbal abuse and poor social relations in the household (Cronbach's alpha = 0.51). We asked a series of questions regarding social support the mother received from a partner, kin members, or friends in different domains, for example, getting rides when needed or if there was someone who 'can watch your child in an emergency' (alpha = 0.47). The mother was asked about her overall health and her child's health status (items drawn from Idler and Angel, 1990).

child care type and observed quality

At waves 1, 2, and 3 we inquired about possible types of non-parental care selected by the mother for the focal child and utilized at least 10 hours per week. Of the original 415 mothers at wave 1, 63 per cent utilized a child care provider of some type within six months of the initial maternal interview. Of these non-parental care settings, we gained access to 66 per cent to administer a set of observational protocols, lasting between four and five hours. To gauge the predictive utility of child care quality, we asked each caregiver about their school attainment, be they a center teacher or home-based caregiver. We earlier showed, with the wave 1 and wave 2 data, how the provider's education level (but not the amount of inservice training received) was related to children's cognitive

proficiency levels at wave 2, after taking into account wave 1 child proficiencies and a variety of covariates (Fuller et al., 2004). We also administered the Early Childhood Environmental Rating Scale (ECERS; Harms et al., 1997). Note that these wave 1 quality measures were taken between three and five years prior to the wave 3 child assessments.[6]

mother's income and work

Participating mothers were asked at each wave whether they were currently employed for pay and whether they were drawing cash aid from the county welfare office. We also asked how many months they had received cash aid during the prior 12 months and whether they had worked for pay over the same period. If so, the mother reported her gross wages. To verify mothers' reported levels of earned income, we obtained administrative data from the California state welfare agency, providing quarterly earnings as reported by employers via the payroll tax system (California Department, 2005).[7]

children's cognitive and social development measures

We assessed children's early cognitive and language development at wave 1 with two subscales of the MacArthur Communicative Development Inventory (CDI; Fenton et al., 1994), one of the few available instruments for children age 12 to 42 months for which reliability and validity studies have been conducted. These measures rely on mother reports of her child's word usage and complexity of oral language. During the wave 2 home visit we administered the Bracken Basic Concept battery, measuring children's cognitive and language proficiencies in several domains (Psychological Corporation, 1998). The assessment consists of six subscales: a school readiness composite, self and social awareness, understanding of direction and position, knowledge of texture and physical materials, grasp of quantities of objects or shapes, and understanding of time and sequence of events. Bracken raw scores are adjusted for the child's age in months, which yields percentile scores relative to US norms.[8]

Our wave 3 child assessment, conducted directly with the child, relied on the Wechsler Intelligence Scale for Children (WISC-IV; Wechsler, 2003).[9] Selected components were utilized to yield composite scores for verbal comprehension, perceptual reasoning, memory, and processing speed. We calculated the full scale score, adjusting for age in months. We report below nationally normed percentile scores.[10] Child assessments at wave 3 were most often conducted in primary schools. During this visit we asked the child's main (homeroom) teacher to complete the Achenbach Child Behavior Checklist and Teachers' Report Form (CBCL; Achenbach and Rescorla, 2001). This 112-item form covers a variety of emotional and behavioral problems that children may display, reported at variable levels of intensity. For the present analysis we report a composite score.

multivariate analytic strategy

We had the opportunity, after collecting three waves of developmental data, to conservatively control on children's prior levels of cognitive proficiency, then estimate long-term association between wave 3 cognitive proficiency and earlier exposure to center programs at wave 1 and/or wave 2. First, we report regression results without entering the wave 1 proficiency control. This specification estimates whether relationships with center attendance observed at wave 2 are still discernable at wave 3. Then, we enter children's prior proficiency levels in estimating wave 3 scores, making the demanding assumption that unobserved selection factors are captured by prior proficiency and other covariates, including center selection factors.

We begin the analysis by predicting maternal choice of center-based over home-based care by using observed factors. With our sample limited to low-income families, the likelihood of selection bias is less than when studying national probability samples. Yet we first attempted to identify factors associated with center selection on which we could control statistically. This does not eliminate the possibility of omitted-variables bias; yet the predictive significance of prior child proficiency levels (at wave 1) in estimating wave 3 cognitive scores suggests that unobservables are not biasing our results. In addition, we estimated mothers' earned income from a variety of predictors, including whether the child attended a center at wave 1. Unobserved maternal practices covarying with center selection would presumably help in estimating mothers' earnings, such as the mother's own cognitive proficiencies or social skills. So, this second method also tested for any bias introduced by omitted variables.

results

results 1 – descriptive patterns

The family sample was drawn evenly between two California counties: San Francisco and Santa Clara (San Jose being the major city, Table 2). About 68 per cent of the mothers had worked for pay during 12 months prior to the wave 3 interview, and 44 per cent had received cash aid.[11] Almost 60 per cent of the mothers reported reading with their children each day. About 47 per cent reported significant symptoms of emotional depression, with CESD scores reaching the clinical cut-off.

About 12 per cent of children attended a center program at both wave 1 and wave 2; another 21 per cent were enrolled at wave 2 only. The dummy predictor we utilize below combines these two indicators of attendance, equaling 33 per cent of sampled children. A greater proportion of girls were enrolled in centers than boys. Just under two-thirds (63%) of children attending centers at wave 1 and wave 2 were girls. Girls displayed significantly higher WISC-IV scores, performing

table 2 additional characteristics and predictors for mothers and children

Variable	*N*	Mean (SD)[1]
Site (percentage residing in)		
San Jose	229	48.5
San Francisco	229	51.5
Mother's work activity at wave 3 (%)		
Worked for pay in past 12 months	229	67.7
Mother received cash aid in past year	225	44.4
Currently working and received aid	225	12.0
Mother's monthly earned income ($)	221	1153 (1118)
Prior maternal mental health (wave 1)		
Percent over CESD threshold, =>16	229	46.7
Reading practices at wave 3		
Percentage of mothers reading daily with child	229	59.4
Percentage of mothers reading rarely	229	7.4
Child care utilization, prior waves (%)		
Child enrolled in center care at wave 1 and wave 2	229	11.8
Child enrolled in center only at wave 2	229	21.4
Child with non-parental care provider at wave 1 and wave 2	229	3.1
Child with non-parental care only at wave 2	229	7.9
Child outcomes at wave 3		
Cognitive assessment (WISC-IV) standardized percentile score[2]		
Girls	94	42.5 (28.1)
Boys	87	31.6 (23.7)
Social-behavior problems (CBCL) standardized (z) scores, teacher-reported[3]		
Girls	84	–0.148 (0.92)
Boys	75	0.142 (1.05)

[1] Standard deviations (SD) only reported for continuous variables.

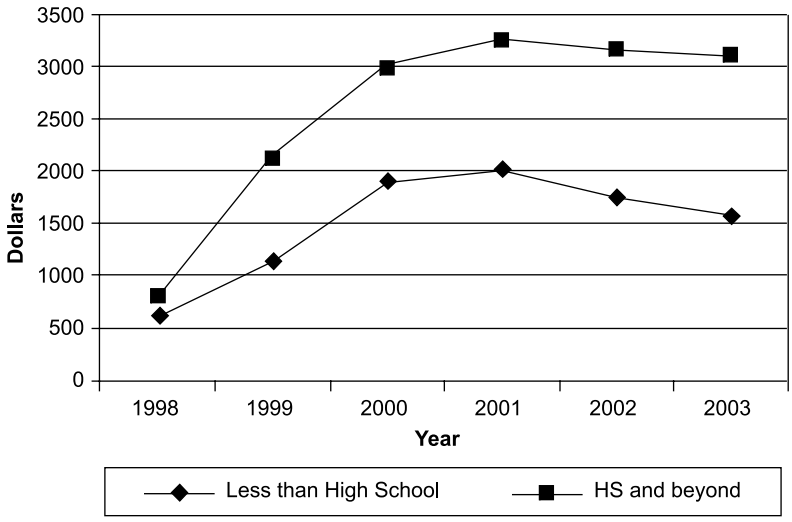
[2] Girls' WISC-IV scores are significantly higher than those for boys ($p < 0.006$). Teacher-reported social outcomes for girls are stronger than for boys, although significant at $p < 0.07$.

[3] Higher values indicate more social and behavioral problems.

at the 43rd percentile at wave 3, on average, compared with boys, whose mean score equaled the 32nd percentile ($p < 0.006$). This holds implications below when we interpret the association between center attendance and cognitive proficiency levels, since girls were more likely to have attended centers.

To understand how home contexts may have changed, as mothers moved into jobs, we plotted their average quarterly income, corresponding to the five

figure 1 mother's quarterly income by education level



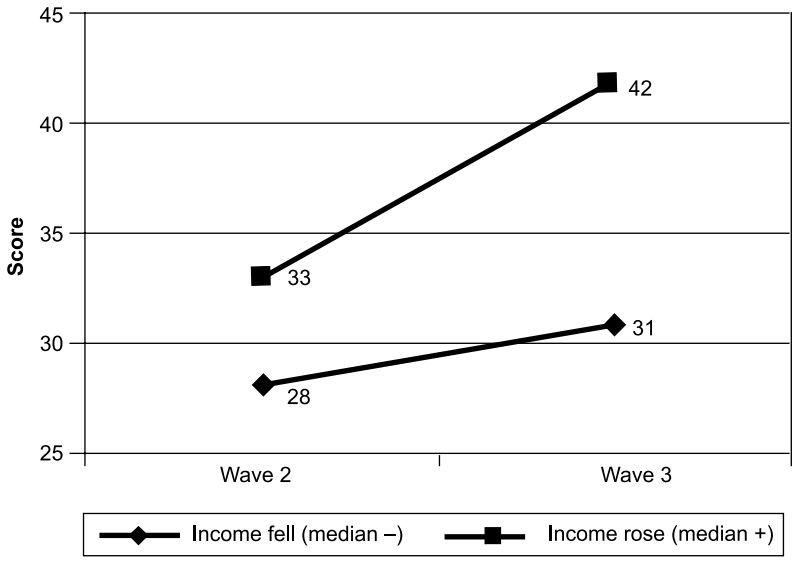
years of participation in the study, split between mothers who had, or had not, completed high school (1998–2003; California, 2005), Figure 1. Earned income rose significantly between wave 1 and wave 2, as many mothers entered the labor force, but then leveled off through wave 3.

results 2 – analysis of child care selection

The growing literature on child care selection emphasizes how certain family or maternal attributes influence the likelihood that a child will enter a center program (e.g. NICHD and Duncan, 2003). An alternative account, especially when focusing on poor families, is that the local availability of centers and institutional forces shape the likelihood of selection, as many families are allocated by public agencies to open slots (Fuller et al., 2004). Under both theoretical accounts, selection of a center program, versus a home-based arrangement, is a non-random event.

Figure 2 suggests that earned income may affect center selection and the child's cognitive growth. We see that cognitive proficiency (percentile) scores rose between wave 1 and wave 2 from the 30th to the 42nd percentile among children whose mothers experienced income gains above the median level. In contrast, children whose mothers fell below the median in terms of income change experienced an insignificant gain, from the 28th to the 31st percentile. But we cannot infer a causal relationship, since the same mothers with rising earnings may have been more likely to send their children to centers.

figure 2 children's cognitive percentile score: by changes in mothers' income (wave 2–wave 3)



modeling center selection

A first step in checking for such selection bias involves estimating which children entered centers or another form of care at wave 1, by specifying a multinomial logit model. Table 3 reports these results, indicating differing probabilities for entry to a center, licensed family child care home, or kith or kin setting. These probabilities of selection are relative to staying at home with a parent (no child care among whites, the base).

We see that mothers who did not complete high school, along with black mothers, were somewhat less likely to have selected a center program (both $p < 0.10$). Of particular importance is the lack of association between center selection and mean quarterly earnings during the 12 months prior to the wave 1 interview. This suggests that a host of unobserved factors captured by maternal income are not systematically related to the likelihood of center selection. Overall, our ability to estimate center selection probabilities is modest at best. The full multinomial model accounts for 14 per cent of the variation in type of child care selected (pseudo r^2).[12]

Is center selection related to maternal income? To further check for the possibility of selection bias we estimated whether the child's center enrollment at wave 1 or wave 2 was significantly related to mother's earned income at wave 3. Maternal income is a robust variable in terms of capturing a variety of a priori maternal attributes that are likely associated with stronger child development. We have ruled out that maternal income helps to explain center selection.

table 3 multinomial logit estimation of the probabilities of type of child care selected at wave 1 (reduced constant sample; unstandardized coefficients and standard errors in parentheses)

	(1) Center	(2) Family child care home	(3) Kith or kin provider
Site control: San Jose resident	–1.42+	0.28	0.06
	(0.77)	(0.98)	(0.65)
Maternal attributes			
Black	–1.57+	–2.19+	–1.66*
	(0.87)	(1.25)	(0.84)
Latina	–1.32	0.52	–0.47
	(0.82)	(0.87)	(0.69)
Mother did not finish high school	–1.20+	–0.83	–0.27
	(0.64)	(0.81)	(0.55)
Mother's mental health (CESD score at or exceeding 16)	0.79	–0.17	–1.34*
	(0.66)	(0.79)	(0.59)
Mother's age (years)	–0.02	0.06	0.03
	(0.05)	(0.06)	(0.04)
Mother's health (scale, 1–5)	–0.36	–0.85*	–0.57
	(0.32)	(0.38)	(0.26)
Maternal employment, welfare			
Monthly earnings ($100s)	0.05	0.08	0.07
	(0.04)	(0.05)	(0.04)
Months on welfare (of prior 12)	0.13	–0.05	0.04
	(0.14)	(0.14)	(0.11)
Mother's support, home, practices			
Social support	0.760+	–0.153	0.922*
	(0.377)	(0.450)	(0.339)
Family stress composite	–0.164	0.222	–0.129
	(0.208)	(0.310)	(0.189)
No. of mother's children in home	–0.060	0.182	0.106
	(0.248)	(0.292)	(0.190)
Frequency of reading, mother and child	–0.001	0.74	0.32
	(0.61)	(0.73)	(0.51)
Child attributes			
Child's age	0.04	–0.06	–0.02
	(0.04)	(0.04)	(0.03)
Child's health (scale, 1–5)	–0.15	–0.08	0.41
	(0.37)	(0.40)	(0.33)
Female child	0.37	–0.12	0.27
	(0.59)	(0.72)	(0.50)
Constant	1.14	2.41	0.59
	(2.78)	(3.44)	(2.48)
Observations (*n*)	131	131	131

+ $p < 0.10$, *$p < 0.05$, **$p < 0.01$.

But it may be that center enrollment at wave 1 or wave 2 is capturing unobserved facets of mothers linked to their success in the labor market.

We see that earned income was lower for black and Latina mothers, while mothers with a high school diploma earned more (Table 4). In column 2 we added two predictors related to the mother's welfare-to-work program involvement: whether she had enrolled in a training program or attended a job-finding workshop. Enrollment in classroom training, but not the workshop, was related to earnings at wave 3. Finally, we see that center selection is not predictive of maternal income, this time taking into account center enrollment at wave 1 or wave 2 (column 3). Center attendance did not contribute significantly to the r^2, nor to the equation's F statistic. Overall, it appears that any unmeasured covariates pertaining to maternal attributes or practices, captured by mother's income, are not related to center selection.

results 3 – center attendance and children's cognitive or social development

Cognitive growth and earlier center attendance

To estimate relationships between center enrollment at wave 1 or wave 2 and children's cognitive status at wave 3, we specified ordinary least-squares (OLS) regression models. The basic model was first run only with families for which complete data from all three waves were available, to allow for a comparison across specified models. We pruned insignificant covariates to conserve on degrees of freedom (Table 5). We also ran estimation models using all available data, which afforded more cases and degrees of freedom.

Column 1 replicates our earlier findings at wave 2, now for the families that remained in the study through wave 3. Importantly, girls displayed higher cognitive proficiency scores, over 10 percentile points higher on the Bracken assessment. African American children scored 21 points lower than whites, and Latinos 17 percentile points lower. Children with mothers who failed to complete high school scored 12 points lower than those whose mothers earned a diploma.

After taking these covariates into account, we see that children who attended a center at wave 1 and wave 2, or at wave 2 only, scored over 7 percentile points higher on the Bracken at wave 2 ($p < 0.06$). When we ran the same model dropping-out child gender and with the full wave 2 data set, including 17 additional families who exited prior to wave 3, the center attendance coefficient becomes significant at $p < 0.01$ (not shown). This suggests that our measure of center participation may be, in part, serving as a proxy for gender, given that girls were more likely than boys to attend centers.

In column 2 we display the same model, but estimate children's wave 3 cognitive proficiency (WISC-IV) scores. The results are similar, with the center-attendance

table 4 ordinary least–squares estimates of mother's earned income at wave 3, as check for unobserved endogeneity (reduced constant sample; unstandardized coefficients and standard errors in parentheses)

	(1) Earned income, wave 3	(2) Earned income, wave 3	(3) Earned income, wave 3
Site control: San Jose resident	–216	–176	–177
	(250)	(263)	(264)
Maternal attributes			
Black	–796**	–819**	–819**
	(293)	(288)	(289)
Latina	–632*	–736**	–737**
	(253)	(252)	(253)
Mother did not finish high school	–701**	–548*	–548*
	(207)	(210)	(211)
Mother's mental health (CESD score	–375+	–388+	–384+
at or exceeding 16)	(213)	(209)	(214)
Mother's age (years)	–12.9	–3.54	–3.48
	(16.5)	(16.2)	(16.3)
Mother's health (scale, 1–5)	–27.3	–31.2	–31.0
	(96.6)	(94.5)	(94.9)
Maternal employment, welfare			
Worked in 12 mos. prior wave 1	–119	–96.1	–96.9
	(204)	(201)	(202)
Participated in classroom training	—	747*	749*
		(304)	(306)
Participated in job–finding workshops	—	–428	–428
		(329)	(330)
Mother's support, home, practices			
Social support	87.0	23.0	23.5
	(151)	(152)	(152)
Family stress composite	–79.0	–65.9	–66.0
	(101)	(99.7)	(100)
No. of mother's children in home	44.9	18.3	17.9
	(94.9)	(93.9)	(94.3)
Child attributes			
Child's age	15.6	17.9	18.2
	(11.4)	(11.5)	(11.8)
Child's health (scale, 1–5)	41.5	45.7	47.5
	(117)	(115)	(117)
Female child	36.3	–2.24	1.59
	(197)	(194)	(199)
Child attended center at wave 2,	—	—	–19.5
or wave 1 and wave 2			(208)
Constant	2215*	1861*	1849*
	(890)	(886)	(898)
Observations (*n*)	140	140	140
R-square	0.18	0.23	0.23

$+p < 0.10$, $*p < 0.05$, $**p < 0.01$.

table 5 Ordinary least–squares estimation of the association between center attendance and children's cognitive proficiency and social–behavioral status at wave 2 or wave 3 (reduced constant sample; unstandardized beta coefficients and standard errors in parentheses)

	(1) W2 Cognitive Proficiency	(2) W3 Cognitive Proficiency	(3) W3 Cognitive Proficiency	(4) W3 Social-Behavioral Problems
Female	10.59***	9.05**	7.49+	–0.23
	(3.64)	(4.12)	(3.95)	(0.18)
San Jose	–5.25	–4.14	–5.20	–0.07
	(4.45)	(5.04)	(4.81)	(0.22)
Black	–21.0***	–20.7***	–20.3***	0.52*
	(5.33)	(6.03)	(5.75)	(0.27)
Latino	–17.0***	–12.2**	–12.4**	0.17
	(4.64)	(5.25)	(5.01)	(0.24)
Mother did not finish high school	–11.5***	–6.87+	–7.43+	–0.10
	(3.62)	(4.09)	(3.91)	(0.18)
Mother depressed (CESD equals or exceeds 16)	–1.72	–5.25	–3.89	0.61***
	(3.71)	(4.20)	(4.02)	(0.19)
Child's Age	0.45**	–0.36	–0.53**	0.02+
	(0.20)	(0.23)	(0.23)	(0.01)
Child attended center at wave 2, or wave 1 and wave 2	7.410*	7.27+	6.72++	–0.21
	(3.87)	(4.38)	(4.18)	(0.20)
Wave 1 cognitive proficiency score (control)			6.71***	
			(1.79)	
Constant	32.30***	58.72***	65.67***	–0.74**
	(7.70)	(8.71)	(8.52)	(0.39)
Observations	142	142	142	120
R–square	0.30	0.18	0.26	0.16

++$p < 0.11$, +$p < 0.10$, *$p < 0.06$, **$p < 0.05$, ***$p < 0.01$.

coefficient indicating that these children scored over seven percentile points higher at age 7½. The center coefficient is marginally significant at $p < 0.10$, given slightly higher error of estimation. We then add the child's cognitive proficiency level at wave 1, as a conservative control which essentially isolates on growth in cognitive skills between wave 1 and wave 3 (column 3). The center-attendance coefficient shows that these children scored over six percentile points higher on the WISC-IV, compared with non-attendees (although insignificant at $p < 0.11$).

Given the modest sample size, the center-attendance coefficients display inconsistent levels of statistical significance. But the size of the coefficient remains stable across specifications, even when controlling on children's prior level of cognitive proficiency. The center coefficient approximates the magnitude of the relationship between mother's attainment of a high school diploma and

children's cognitive proficiency. When we specify a model that drops out child gender, the center-attendance coefficient grows larger and is estimated with less error (significant at $p < 0.01$).[13]

Figure 3 illustrates the general pattern of cognitive growth observed between wave 2 and wave 3 with no statistical controls. The higher plot shows gains in percentile scores for those children who attended a center at wave 2. Their scores rose from the 38th to the 41st percentile. In contrast, those children not enrolled in a center program scored at the 25th percentile at wave 2, climbing to the 33rd at wave 3, perhaps capturing regression toward the mean among non-center attendees. Yet children who attended centers continued to show growth and ranged higher at wave 3 in their cognitive proficiencies, albeit a slower rate of growth.

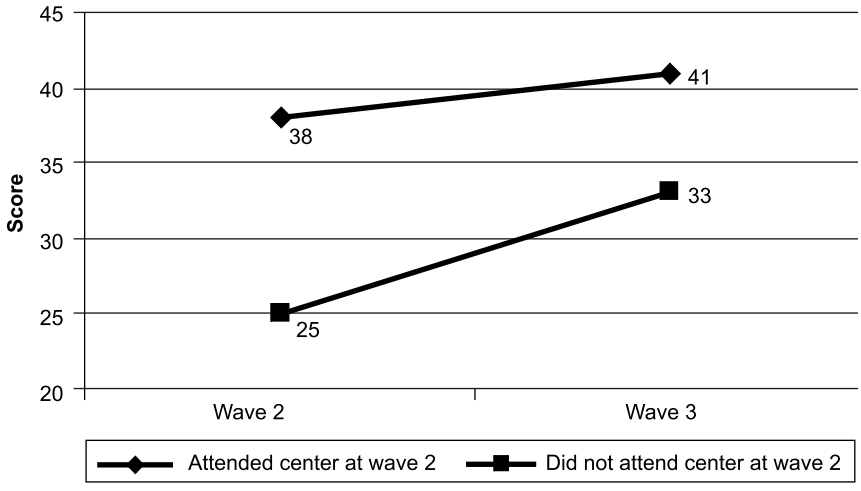
provider quality and cognitive proficiencies

We observed no significant associations between the two quality measures taken at wave 1 and children's WISC-IV scores at wave 3. The small share of children enrolling in a center at wave 1, when quality measures were administered, may further explain the lack of association between center quality and children's cognitive proficiencies at wave 3.

center attendance and social-behavior problems

The same OLS model estimated whether center attendance was associated with stronger social-behavioral development. But we found no significant

figure 3 children's cognitive percentile score: by wave 2 center participation



relationships – positive or negative – between center attendance and CBCL scores at wave 2 or wave 3. Teachers reported a significantly lower incidence of behavior problems for girls than for boys. Children whose mothers showed signs of emotional depression displayed CBCL scores that were 0.47 SD higher than for children with emotionally healthy mothers, after taking into account the same covariates and selection factors.

discussion

These findings show that earlier attendance in a center continues to predict higher cognitive proficiency between three and five years later, after taking into account a variety of covariates. Center attendees displayed cognitive scores between 6.7 and 7.3 percentile points higher (WISC-IV), compared with non-attendees, net the effects of all covariates and depending on inclusion of prior proficiency levels. These differences equal between 0.18 and 0.21 SD – modest yet between twice and three times the effect sizes estimated in recent analyses of national samples (Magnuson et al., 2007; NICHD, 2005). This suggests that persisting effects of center attendance may be stronger for children from lower-income, compared with middle-class, families.

At the same time, our descriptive analysis shows that growth trajectories converged somewhat between age 4½ and 7½ years of age, suggesting that the initial cognitive boost associated with center attendance is greatest at school entry and then diminishes as children move through primary school. We observed no relationship between center attendance and social development. Overall, the push on mothers to work more outside the home yielded an indirect benefit, as many children gained access to center programs, consistent with other studies conducted in other states (Morris, et al., 2001).

The generalizability of these results is constrained by a significant level of sample attrition. Unobserved attributes of those families that remained in the study may differ in non-random ways, compared with those who could not be tracked over time. The attrition rate that we experienced is comparable to other field studies with poor populations. Some estimation models showed borderline levels of statistical significance for the center-attendance predictor. Yet with a modest increase in the number of family cases used in the estimation models the relationship between center attendance and long-term cognitive proficiency was estimated with less error.

acknowledgements

The authors, listed in alphabetical order, contributed equally. This article stems from the Growing Up in Poverty Project, co-directed by Fuller and Kagan, along with Susanna Loeb at Stanford University. Several private foundations, along with federal and state governments, supported this longitudinal study in the wake of the 1996 welfare reforms

in the United States. The wave 3 data collection was co-directed by Desiree French and Kalina Wong. Major supporters of the study included the Casey, MacArthur, Packard, and Spencer foundations, along with three Haas family funds based in San Francisco. The state of California supported long-term tracking of study participants. This decade-long effort would not have been possible without the generous support of Hedy Chang, Susan Dauber, Amanda Feinstein, Mike Laracy, Alette Lundeberg, Jan McCarthy, Michele Rutherford, Trent Rohrer, Jolene Smith, and Marie Young.

notes

1. We use the term *child care center*. The designers of the most recent federal survey of child care programs concluded that no clear boundary exists between organizations calling themselves *centers* or *preschools*, nor were quality indicators or the formalization of curriculum associated with one label or the other (Kisker et al., 1991).
2. Benefits appear to persist into first grade for children from low-income families and for the mean (middle-class) child attending a primary school in which teachers reported more intensive instructional activities (Magnuson et al., 2004). Garces et al. (2002) also found higher levels of school achievement for Head Start attendees, especially for Latino and white children with more highly educated mothers, even after matching siblings who received differing levels of exposure (also Currie and Thomas, 1999).
3. Parallel family samples were drawn in Connecticut and Florida, but these mothers and children were followed only through wave 2.
4. US counties vary in defining which single-parents and children are eligible to receive cash aid and work supports, like child care, to meet state work requirements. In 1998, as our sample was being drawn California set income eligibility at about the federal poverty line and required that the mother was caring for a resident child under age 18 (Fuller and Kagan, 2000).
5. The NICHD study retained 44 per cent of the original subsample of children from low-income families between age 1 and 54 months (NICHD, 2006).The NICHD's birth sample in 1991 equaled 1364 children, including 21.5 per cent from families with an income-to-needs ratio of 1 or lower, the defined poverty cut-off. When children averaged 4½ years of age the total sample equaled 1095, of whom 11.8 per cent resided in poor families (NICHD, 2006). So, the total attrition rate was 56 per cent for this subgroup which is comparable to children participating in our study. The Early Childhood Longitudinal Study, Birth Cohort study, led by the National Center for Educational Statistics, retained 63 per cent of its original birth sample over a four-year period (Park, 2007).
6. Centers attended by participating children displayed higher quality than levels observed in earlier studies that included samples of centers in California. San Jose centers attended by study children displayed an average ECERS score of 5.8 (on a seven-point scale), compared with a 4.5 for the 100 California centers sampled in the earlier Cost, Quality, and Child Outcome Study (1995), and a 4.1 mean score for centers sampled in the Growing Up in Poverty measurement study (Holloway et al., 2001). Average class size ranged lower for centers in the present study: 15.6 and 14.5 children in San Francisco and San Jose centers, respectively, compared with 17.3 children in Holloway et al. (2001).

7. Administrative records do not capture informal sources of income, a topic about which we asked in the maternal interview (providing 'child care to friends', 'doing hair', or other work activities).
8. Given sample attrition and uneven access to each participating child, we estimated wave 2 Bracken scores for 32 children, based on wave 1 and wave 2 predictors. These scores were predicted (imputed) from maternal and home factors that were related to wave 2 Bracken scores, explaining 0.54 of the variance in observed Bracken scores. Methods for imputing missing values through regression estimation are detailed in Belin et al. (1993) and Little (1992).
9. We originally administered the Bracken instrument utilized in wave 2, but soon discovered that the items overall were insufficiently challenging for children in the upper age range of our child cohort, despite the publisher's claims to the contrary. We retained nationally normed Bracken scores for 23 young children that did not approach any discernible ceiling. Each instrument behaved in very similar ways, not surprising since each is age-adjusted and nationally normed.
10. At wave 3 all Asian American children (primarily Vietnamese) were assessed in English. No Vietnamese version of the WISC-IV is available. Asian membership was never significantly associated with child care selection, or with cognitive or social-behavioral child outcomes.
11. Nearly one-third of the mothers reported a mix of income from jobs and cash aid in the prior year.
12. Note that this model is run only using families for which three waves of complete data are available. When the model was run on the full wave 3 sample ($n = 229$), the findings were even weaker. Specification of the selection model draws from the earlier literature on child care selection (e.g. Fuller et al., 1996; Loeb et al., 2004; NICHD and Duncan, 2003).
13. We don't know whether girls are disproportionately benefiting from center enrollment, or prior factors boost girls' cognitive growth independent of center attendance (no interaction effect was detected).

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