MONOGRAPHS OF THE SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT

III. IMPACTS OF EARLY HEAD START PARTICIPATION ON CHILD AND PARENT OUTCOMES AT AGES 2, 3, AND 5

Cheri Vogel, Jeanne Brooks-Gunn, Anne Martin, and Mary M. Klute

In this chapter, we describe the impacts that EHS participation had on children's participation in formal center-based programs after leaving EHS and follow this with a presentation of the impacts of the EHS program for the total sample at three time points—when the children were 2, 3, and 5 years old. We conducted three different analyses, the first estimating impacts at each age, the second using growth curve analyses to estimate impacts across all three ages, and the third examining possible age 3 mediators of impacts seen at age 5. Subgroup analyses are presented in later chapters (child and family characteristics in Chapter IV and program service delivery characteristics in Chapter V).

Impacts at age 2 provide a picture of the progress of the EHS group (compared to the control group) at a mid-point during the receipt of EHS services. Impacts at age 3 compare the two groups at the end of the intervention, and impacts at age 5 compare the groups 2 years after the intervention ended. The first set of impacts (at age 2) might be labeled "intermediate" effects, the second (at age 3) "end-of-program" effects, and the third (at age 5) "postintervention" effects.

As a comprehensive program, EHS services target a wide range of areas intended to benefit children, their parents, and their families (ACF, 2002b; Berlin, Brooks-Gunn, & Aber, 2001; Connell & Kubisch, 2001). Consequently, we collected a rich array of measures, including the following domains: child social, emotional, and attention outcomes; child language, cognitiveg, and academic skills; child health; parenting and the home environment; family well-being and mental health; and parent self-sufficiency. In total, the EHS evaluation assessed 9 child outcomes at ages 2 and 3, and 10 at age 5. There were 13 family outcomes at all three ages. See Chapter II for details on study design and measures.

Corresponding author: Jeanne Brooks-Gunn, Teachers College and the College of Physicians and Surgeons, Columbia University, 525 West 120th Street, New York, New York 10027, email: brooks-gunn@columbia.edu

In creating Head Start's new program serving low-income pregnant women and families with children from birth (or prenatally) to age 3, the Advisory Committee on Services for Families with Infants and Toddlers recommended that programs seek to place children leaving EHS in high-quality, formal early childhood programs in which the children could receive services between the age of 3 and entry into kindergarten (U.S. Department of Health and Human Services [USDHHS], 1994).

After leaving their EHS program, the EHS sample, as a group, no longer had consistent access to the kinds of support they received while enrolled. In addition, a substantial percentage of families left EHS before their child turned 3, perhaps even before the program had developed a transition plan. Thus, we could examine the impacts on program participation between the ages of 3 and 5 when (1) parents largely had to find programs and care arrangements on their own; (2) many Head Start and other prekindergarten programs (where they existed) did not enroll children until they were age 4, potentially creating a gap in services between leaving EHS and entering Head Start; (3) some families received help in finding child care and other program arrangements from an EHS, Head Start, or similar program; and (4) a wider variety of programmatic experiences was possible.

At age 5, we asked parents about children's formal program experiences from ages 3 to 5. Formal program experiences included center-based child care, prekindergarten programs, and Head Start. Former EHS children were more likely to attend a formal program at both ages 3–4 and 4–5 than non-EHS children ($p < .05$), although fewer than half of EHS children (47%) attended a formal program at both ages. Former EHS children were also more likely to have attended Head Start during this period ($p < .01$): 55% of former EHS children attended Head Start (Table 2). This exposure to formal center-based programs by both the EHS and control group children is important context for our analysis of EHS program impacts at age 5.

IMPACTS ON CHILD AND PARENT OUTCOMES AT AGES 2, 3, AND 5

Research Questions

The overall analyses presented in this chapter focus on the impacts of EHS across all 17 sites. The sites differed in the mix of services offered to families (in Chapter V, we present findings by the three different approaches that sites used—home-based only, primarily center-based, and a mix of home-based and center-based services). In formulating our hypotheses, we considered results from previous early childhood education (ECE) evaluations that included children up to age 3, both those that were home visiting programs and those that were a combination of home visiting and center

TABLE 2

OVERALL IMPACTS OF EARLY HEAD START ON PROGRAM PARTICIPATION AFTER EARLY HEAD START

Outcome (Percentages)	Program Group	Control Group	Estimated Impact	Effect Size[a]
Any Formal Program Participation				
Ages 3–4	49.0	43.6	5.4*	.11
Ages 4–5	81.7	82.3	−0.5	−.01
Ever 3–5	89.6	88.2	1.3	.04
Both Ages	46.6	41.9	4.7*	.10
Head Start Participation				
Ages 4–5	47.2	42.8	4.4*	.09
Ever 3–5	54.9	48.8	6.0**	.12
Other Formal Program Participation				
Ages 4–5	50.2	55.3	−5.1*	−.10
Ever 3–5	59.4	62.9	−3.5	−.07
Other				
Total Time in All Formal Programs (Months)	13.5	13.1	0.4	.06
Ever in Informal Care (Percentage)	56.1	51.9	4.2*	.08
Sample Size[b]	**934–1,071**	**856–991**		

Source. Parent interviews, interviewer observations, and assessments of semistructured parent–child interactions conducted when children were in their prekindergarten year.

Note. All impact estimates were calculated using regression models, in which each site was weighted equally. $^{+}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

[a]The effect size was calculated by dividing the estimated impact by the standard deviation of the outcome measure for the control group.

[b]Sample varied slightly depending on the outcome variable.

based (none of the previous intervention programs for young children were only center based).

We had several expectations for the overall impact analyses. First, we expected that impacts would be more likely during the program than 2 years after it concluded (i.e., at ages 2 and 3 vs. age 5). Other program evaluations targeting young children and families have reported stronger effects at the end of a program than years later (e.g., Barnett, 1995; Brooks-Gunn, 2011; Brooks-Gunn et al., 1994; Camilli et al., 2010; Karoly et al., 2005). Effect sizes are often smaller than those seen earlier 2 or more years after the treatment ends. The timing of EHS effects at age 2 versus 3 was difficult to predict. On the one hand, one might expect effects to appear by age 2, given that the families entered the program during a mother's pregnancy or during a child's first year of life (median age of entry about 6 months). On the other hand, if more intervention services are needed to alter a particular behavior, or if emerging behaviors at age 3 are more influenced by the intervention than by precursors at age 2, then effects might be stronger at the later age. It is important to note that by age 2, families had between 14 and 27 months of

intervention services (depending on when they entered EHS); given the variation in service length, which was allowed by the research design, many families had not had 2 years of intervention when the age 2 assessment was conducted. Similarly, at the time of the age 3 assessment, the duration of family program participation averaged 22 months. This design feature is different from previous ECE evaluation in which families were recruited in a much narrower developmental frame.

Second, we expected that the strongest effects would be seen for parenting behavior and the home environment, given the emphasis that EHS programs placed on this aspect of family life and the comprehensive services provided by the program (ACF, 2002b). Additionally, well-evaluated home visiting programs for young children and their families are most likely to exhibit effects in this domain, compared to other domains (Brooks-Gunn, Berlin, & Fuligni, 2000; Howard & Brooks-Gunn, 2009; Sweet & Appelbaum, 2004). Although EHS programs varied by program approach in the amount of home visiting offered and the extent to which they offered center-based care, virtually all children and families did receive home visits, although the number of visits was much smaller in center-based programs than in home-based and mixed-approach programs (see Chapter V).

Third, whereas parenting distress and mental health are usually targeted by home visiting programs, past literature is mixed as to the benefits in this domain (see Table 2 in Howard & Brooks-Gunn, 2009). The EHS program is not a mental health program. Thus it seemed more likely that EHS would reduce parenting distress and possibly family conflict than maternal depression.

Fourth, we expected EHS to affect child outcomes in the language, cognitive, social, emotional, and approaches to learning domains. Previous ECE program evaluations have reported such findings, although past evaluations have not included the rich array of measures used in the EHS study. The EHS evaluation assessed not only behavior problems, as have most past evaluations, but also social behavior problems, attention, engagement with the mother, and emotion regulation. Given the emphasis EHS program staff placed on these aspects of development, we expected to find effects across these measures. We expected that children's language would be enhanced by the EHS program; however, we expected that the overall impacts would be smaller than those seen in previous evaluations of center-based programs for infants and toddlers (such as the Abecedarian Project and IHDP). In general, rigorous evaluations of home visiting programs have found either small or no effects on young children's language and cognitive development (Gomby, 2005; Howard & Brooks-Gunn, 2009; Sweet & Appelbaum, 2004). Given the moderate intensity of center-based services, and the likelihood that home-based services might not affect language/

cognition, we expected effects to be small when averaged across the entire sample.

Analytic Approach

We present the impacts of participation in EHS on child and family outcomes as differences in mean outcomes between the program and control groups. To increase the precision of our estimates, we estimated regression-adjusted means for each group. Each site was weighted equally because EHS services are administered at the site level and differ across programs. The impacts are presented as two-tailed tests. They are not corrected for multiple comparisons. Historically, evaluations of early childhood interventions, including meta-analyses that have been conducted, do not correct for multiple comparisons. Social science disciplines differ on their criteria for assessing significance, although most scholars look at patterns within findings, an approach that we have adopted.

We defined an EHS participant as a program group member who received more than one EHS home visit, met with an EHS case manager more than once, received at least 2 weeks of EHS center-based care, or participated in a group activity. Because 91% of those families assigned to EHS participated by this definition, we found very few differences between impact estimates based on two-stage least squares regression (treatment on the treated or TOT) and those based on ordinary least squares regression (intent to treat or ITT). Both estimates are shown in the tables reporting impacts in this chapter and in Chapters IV and V; in the text, however, we focus on the TOT impacts. The control group mean is based on the control group members who would have participated in EHS if they had been assigned to the program group instead. This unobserved mean was estimated as the difference between the program group mean for participants and the impact per participant. The estimated impact per participant is measured as the estimated impact per eligible applicant divided by the proportion of program group members who participated in EHS services (which varied slightly by site; see ACF, 2002a for more details). Psychometric information on specific outcomes and descriptive statistics are in Chapter II.

Table 3 presents the findings for the child, parent, and family outcomes at ages 2, 3, and 5. The effect size (ES) was calculated by dividing the estimated impact per participant by the standard deviation of the outcome measure for the control group (Cohen's *d*; Cohen, 1988). We report significant impacts when $p < .05$ or $< .01$; we report impact estimates with $p < .10$ as approaching significance or as trends when they contribute to a conceptually consistent pattern of impacts across multiple outcomes. We estimated separate models for each outcome measure and discuss results for each of the child, parent, and family domains outlined previously.

TABLE 3

IMPACTS ON SELECTED CHILD AND FAMILY OUTCOMES AT AGES 2, 3, AND 5: FULL SAMPLE

	Program-Control Differences, Full Sample														
	Age 2					Age 3					Age 5				
Outcome	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]
Child Social–Emotional and Approaches to Learning Outcomes															
CBCL Aggressive Behavior	12.2	13.0	−0.8	**−0.12***	**−0.11***	10.6	11.3	−0.7	**−0.11***	**−0.09**+	10.6	11.0	−0.4	−0.05	−0.04
FACES Social Behavior Problems											5.3	5.7	−0.4	**−0.12***	**−0.10***
Negativity Toward Parent During Play	1.7	1.8	−0.1	−0.07	−0.07	1.2	1.3	−0.1	**−0.14***	**−0.12***	1.2	1.3	−0.0	−0.02	−0.03
Engagement During Play	4.3	4.2	0.1	**0.09**+	**0.08**+	4.8	4.6	0.2	**0.20****	**0.18****	4.7	4.7	−0.0	−0.01	−0.01
Sustained Attention with Objects During Play	5.0	5.0	0.1	0.07	0.07	5.0	4.8	0.2	**0.16****	**0.14****					
FACES Positive Approaches to Learning											12.2	11.9	0.3	**0.14****	**0.12****
Observed Bayley Emotion Regulation[e]	3.6	3.7	−0.0	−0.01	−0.01	4.0	4.0	0.0	0.01	0.00					
Observed Leiter Emotion Regulation											91.2	90.9	0.3	0.03	0.02
Observed Attention											8.6	8.4	0.2	**0.09**+	**0.08**+
Leiter Attention Sustained											10.9	10.9	0.1	0.02	0.01
Child Language/Cognitive/Academic Skills															
MacArthur CDI Vocabulary	56.5	53.8	2.7	**0.12***	**0.11***										
English Receptive Vocabulary (PPVT)						83.3	81.1	2.1	**0.13***	**0.11***	92.0	90.7	**1.3**	**0.09**+	0.07
Spanish Receptive Vocabulary (TVIP)						97.2	94.9	2.3	0.27	0.25	90.0	83.0	7.0	**0.29***	**0.26***
Average Bayley MDI	90.0	88.0	2.1	**0.15****	**0.14****	91.4	89.9	1.6	**0.12***	**0.11***					
Percentage Bayley MDI <85	34.1	40.9	−6.8	**−0.14****	**−0.12****	27.3	32.0	−4.7	**−0.10**+	**−0.08**+					
Woodcock Johnson Letter-Word Identification (English)											89.6	90.4	−0.9	−0.06	−0.06
Woodcock Johnson Applied Problems											89.8	88.4	1.4	0.07	0.05
Child Health															
ER Visit Due to Accident or Injury	7.0	8.8	−1.9	−0.07	−0.06	10.2	10.9	−0.8	−0.02	−0.02					
Any Immunizations[f]	98.3	96.5	1.8	**0.10***	**0.09***	99.0	97.7	1.2	**0.09**+	**0.07**+					

(*Continued*)

TABLE 3. (*Continued*)

Outcome	Program-Control Differences, Full Sample														
	Age 2					Age 3					Age 5				
	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]
Child Has Individualized Education Plan[g]	3.6	3.9	−0.3	−0.02	−0.02	7.7	5.7	2.0	**0.09**$^{+}$	0.08	7.9	7.6	0.3	0.01	0.02
Speech Problems (low score = fewer)											18.8	22.7	−3.9	**−0.09**$^{+}$	**−0.07**$^{+}$
Parenting and the Home Environment															
HOME Language and Literacy	10.3	10.1	0.2	**0.13****	**0.12****	10.6	10.4	0.2	**0.10***	**0.09***	10.4	10.3	0.1	0.03	0.02
Percent Reading Daily	57.9	52.1	5.8	**0.12***	**0.10***	56.8	52.0	4.9	**0.10***	**0.09***	34.0	29.3	4.8	**0.10***	**0.09***
Percent Spanked Last Week	47.2	52.9	−5.7	**−0.11***	**−0.11***	46.7	53.8	−7.1	**−0.14****	**−0.13****	35.4	36.6	−1.2	−0.03	−0.02
Parent Supportiveness During Play	4.1	4.0	0.1	**0.08**$^{+}$	**0.09**$^{+}$	4.0	3.9	0.1	**0.15****	**0.13****	4.0	3.9	0.1	0.06	0.05
Parent Detachment During Play	1.4	1.5	−0.1	**−0.10***	**−0.10***	1.2	1.3	−0.1	**−0.09**$^{+}$	**−0.09**$^{+}$					
Percent Regular Bedtime	61.1	55.4	5.7	**0.11***	**0.10***	59.4	58.2	1.3	0.03	0.03					
Teaching Activities	4.6	4.5	0.1	**0.10***	**0.09***	4.4	4.3	0.1	**0.09**$^{+}$	0.07	11.3	11.0	0.3	**0.11***	**0.09***
Children's Books (26 or more)											64.1	59.9	4.1	**0.08**$^{+}$	**0.07**$^{+}$
Parent Attends Meetings/Open Houses[h]											87.5	79.2	8.3	**0.21****	**0.19****
Family Well-Being and Mental Health															
Depression[i]	15.4	15.4	−0.0	0.00	0.00	7.4	7.7	−0.3	−0.04	−0.04	7.4	8.3	−0.9	**−0.12***	**−0.10***
Parenting Distress	24.8	25.9	−1.2	**−0.12***	**−0.11***	24.7	25.5	−0.7	−0.08	−0.07					
Family Conflict	1.7	1.7	−0.1	**−0.10***	**−0.09***	1.7	1.7	−0.0	−0.04	−0.04					
Someone in Household Had Alcohol/ Drug Problem, Past Year											7.9	10.5	−2.5	**−0.08**$^{+}$	−0.07
Child Witnessed Violence											11.4	11.2	0.1	0.0	0.00
Parent Self-Sufficiency															
Employed[j]	74.3	71.7	0.3	0.06	0.05	86.8	83.4	3.4	**0.09**$^{+}$	**0.08**$^{+}$	3.6	3.5	0.1	0.04	0.03
In School or Job Training[k]	46.9	41.9	5.0	**0.10***	**0.09***	60.0	51.4	8.6	**0.17****	**0.16****					
Income (dollars)[l]	14498.2	14864.2	−366.0	−0.03	−0.02	16871.7	17813.1	−941.4	−0.07	−0.07	2337.8	2258.6	79.3	0.04	0.03
Sample Size															
Parent interview	**1,118**	**1,048**	**2,166**			**1,105**	**999**	**2,104**			**978**	**1,084**	**2,062**		

(*Continued*)

TABLE 3. (*Continued*)

Outcome	Program-Control Differences, Full Sample														
	Age 2					Age 3					Age 5				
	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]	Program Group Participants[a]	Control Group[b]	Impact Estimate[c]	Effect Size (TOT)[d]	Effect Size (ITT)[d]
Parent–child interactions	**941**	**855**	**1,796**			**874**	**784**	**1,658**			**827**	**890**	**1,717**		
Bayley	**931**	**850**	**1,781**			**879**	**779**	**1,658**			**NA**	**NA**	**NA**		
Child assessments	**994**	**918**	**1,912**			**928**	**832**	**1,760**			**836**	**919**	**1,755**		

Source. Parent interviews, interviewer observations, and assessments of semistructured parent–child interactions conducted when children were in their prekindergarten year. HOME, Home Observation for Measurement of the Environment; CBCL, Child Behavior Check List; FACES, Family and Child Experiences Survey; PPVT, Peabody Picture Vocabulary Test; TVIP, Test de Vocabulario de Imagines Peabody.

Note. All impact estimates were calculated using regression models in which each site was weighted equally. All values in the tables are based on two-stage least squares analyses (treatment on treated) except for the columns that depict effect sizes based on ordinary least squares comparisons (intent to treat). Psychometric information on specific outcome measures, including descriptive statistics, is available in Chapter 2.

[a]A participant is defined as a program group member who received more than one Early Head Start home visit, met with an Early Head Start case manager more than once, received at least 2 weeks of Early Head Start center-based care, and/or participated in Early Head Start group parent–child activities.

[b]The control group mean is the mean for the control group members who would have participated in Early Head Start if they had been assigned to the program group instead. This unobserved mean was estimated as the difference between the program group mean for participants and the impact per participant.

[c]The estimated impact per participant is measured as the estimated impact per eligible applicant divided by the proportion of program group members who participated in Early Head Start services (which varied by site). The estimated impact per eligible applicant is measured as the difference between the regression-adjusted means for all program and control group members.

[d]The effect size was calculated by dividing the estimated impact per participant by the standard deviation of the outcome measure for the control group. For ease of reading, all statistically significant effect sizes appear in bold.

[e]Emotion regulation measured at ages 2 and 3 with the Bayley Behavior Rating Scales and at age 5 with the Leiter-R observer ratings.

[f]Reported as percentage of children who had received any immunizations by the time of each interview.

[g]At age 2 the time frame for this question is 15 months after random assignment. At age 3 the time frame is 26 months after random assignment. At ages 2 and 3 this item is measured as eligible for early intervention services.

[h]Includes only parents whose children were in a formal program. Sample sizes for this outcome were $N = 440$ and $N = 467$ for program and control groups, respectively.

[i]Depression measured with the Composite International Diagnostic Interview (CIDI) at age 2.

[j]At age 2 the time frame for this question is 15 months after random assignment, and at age 3 the time frame is 26 months after random assignment. At each earlier age the item is whether employed or not, but at age 5 we asked "How much time in the past 6 months have you held a job or jobs in which you worked at least 20 hr per week?" Answers were on a 5-point scale from 1 = *never* to 5 = *all of the time.*

[k]At age 2 the time frame for this question is 15 months after random assignment, and at age 3 the time frame is 26 months after random assignment.

[l]At age 2 the time frame for this question is 15 months after random assignment, and at age 3 the time frame is 26 months after random assignment. Amounts are annual income at ages 2 and 3 and monthly income at age 5.

$^{+}p < .10$; $^{*}p < .05$; $^{**}p < .01$.

Child Social–Emotional Outcomes and Approaches to Learning Outcomes

We found positive impacts on several outcomes. By age 3, program group children exhibited less negativity toward their mother and were also more engaged with them (ES = .14, $p < .05$, and .20, $p < .01$, respectively).

The program group showed lower child aggression than the control group as reported by mothers at both ages 2 and 3. The effect sizes were .09, $p < .05$, and .11, $p < .05$. Group means were not significantly different at age 5 (ES = .05). However, at age 5, social behavior problems, as measured by the FACES scale, were significantly higher in the control group (ES = .12, $p < .05$).

Sustained attention with objects was higher in the program group at age 3 (ES = .16, $p < .01$) but not at age 2. Also, at age 5, the program group showed more positive approaches to learning (this FACES measure also taps social skills; ES = .14, $p < .01$) and better observed attention on the Leiter rating scales (ES = .09, $p < .10$). Emotion regulation as observed during the Bayley and Leiter Test assessments did not differentiate the groups.

Child Language, Cognitive, and Academic Skills

EHS enhanced children's cognitive skills at both ages 2 and 3, as evidenced by higher Bayley Mental Development Index (MDI) scores (ES = .16, $p < .01$, and .12, $p < .05$, respectively). Vocabulary was positively affected at both ages as well (ES = .12 for age 2 CDI vocabulary, $p < .05$, and .13 for the PPVT-III at age 3, $p < .05$). At age 5, PPVT-III scores were also positively affected (ES = .09, $p < .10$). For those children taking the Spanish version of the PPVT, we found no significant differences at age 3 (ES = .25), although these became significant at age 5 (ES = .29, $p < .10$). The group of children taking the TVIP was small, particularly at age 5.

In contrast, we found no group differences on the early achievement test scores at age 5 (Woodcock Johnson Letter-Word, Applied Problems, and Leiter Attention Sustained).

Child Health Outcomes

When children were ages 2 and 3, those in the program group were more likely to have had an immunization (ES = .10, $p < .05$, and .09, $p < .10$), although the overall rate of immunizations was very high (more than 95% in the control group at both ages). At age 5, somewhat fewer children in the program group had speech problems (ES = .09, $p < .10$). There were no differences in ER visits due to accidents or injuries.

Parenting and the Home Environment

When the children were ages 2 and 3, mothers in the program group reported engaging in more stimulating activities with their children than the

control group. EHS mothers had higher HOME language scores (ES = .12, $p < .01$ and ES = .10, $p < .05$), were more likely to read daily to their children (ES = .12, $p < .05$ and ES = .10, $p < .05$), initiated more teaching activities (ES = .11, $p < .05$ and ES = .09, $p < .10$), exhibited greater supportiveness during play (ES = .09, $p < .10$ and ES = .15, $p < .01$), and were more likely to set a regular bedtime at age 2 (ES = 12, $p < .05$). At age 5, effects were sustained for reading daily and for teaching activities (ES = .10, $p < .05$ at age 2, and ES = .11, $p < .05$ at age 3). Former EHS children were also somewhat more likely to have at least 26 books in their homes (ES = .08, $p < .10$), although there were no longer any significant differences for HOME language scores or supportiveness during play (ES = .03 and .06). In addition, mothers of the 5-year-olds who participated in EHS (and were enrolled in a formal program at that time) were more likely to attend meetings at the child's school (ES = .21, $p < .01$).

With respect to negative parenting, mothers in the program group were somewhat less likely to exhibit lower levels of detachment during play (ES = .10, $p < .05$, and ES = .09 at ages 2 and 3, respectively) and were less likely to report spanking their children (ES = .11, $p < .05$ at age 2 and ES = .14, $p < .01$ at age 3). These differences were not evident at age 5.

Family Well-Being and Mental Health

EHS lowered parenting distress and family conflict at age 2 (ES = .12, $p < .01$, and ES = .10, $p < .05$, respectively), but not at age 3 (ES = .08 and .04). Maternal depression scores were the same in the two groups when the children were 2 and 3 years of age; however, the mothers in the control group had higher depression scores at age 5 than those in the program group (ES = .12, $p < .05$).

In addition, at age 5, mothers in the program group were somewhat less likely to report that a household member had had an alcohol or drug problem in the past year (ES = .08, $p < .10$). There were no group differences in violence toward the mother or violence witnessed by the child at age 5.

Parental Self-Sufficiency

Mothers in the program group were somewhat more likely to be employed at age 3 (ES = .09, $p < .10$) but not at ages 2 or 5. The percentage of employed mothers was high—72% in the control group at age 2 and 83% at age 3. Additionally, at both ages 2 and 3, EHS mothers were more likely to be in school or in job training (ES = .10, $p < .05$, and .17, $p < .01$). Between 44% and 51% of the control group mothers and 48–60% of the EHS group were in school or in job training during the EHS program, which is relatively high, especially given their relatively high rate of employment (over 70%).

Apparently, many mothers were juggling work and training simultaneously. We found no group differences in income at any age point. Given that so many mothers in both the EHS and control groups were employed, this finding is not surprising.

GROWTH CURVE ANALYSES

Research Questions

In this section we report on using growth curves to examine when differences between the program and control groups emerged and whether those differences widened or narrowed over time. In most cases, the first time point examined corresponds to child age 2, and the additional points are ages 3 and 5. If differences between the program and control groups were to widen over time, it would suggest a "snowball effect" wherein early gains from EHS participation produced steeper growth over time. If differences were to narrow, it would be useful to pinpoint when they began to do so. It would also be useful to identify whether the narrowed treatment impact reflected a decline in status of the program group, a rise in status of the control group, or both. The answers could suggest when supportive services should be optimally offered to either or both groups.

The present analysis focuses on five of the outcomes: child cognitive ability, child aggressive behavior, maternal supportiveness, the home environment, and maternal depression. These outcomes were selected because they were assessed at all three time points, and were measured with continuous rather than categorical variables (both are requirements for growth curve analysis).

Our predictions were informed by findings from the cross-sectional impact analyses. First, given the consistent impacts over time for aggressive behavior and social problems, we expected that impacts would be seen at age 2 and continue, although the size of the effect would not increase over time. Second, because the cognitive measures exhibited more consistent program effects at ages 2 and 3 than at age 5, we expected that initial effects at age 2 would either continue at the same magnitude or become greater by age 3, followed by a diminution of effects at age 5. Third, we expected treatment effects for maternal supportiveness to appear at age 2, be sustained at age 3, and diminish somewhat at age 5. We expected impacts on the home language and learning environment to show a similar trend.

Fourth, we were unsure as to what the developmental pattern might be for treatment effects on maternal depressive symptoms. Some previous ECE evaluations have reported reductions in such symptoms though others have not. EHS did not influence maternal depressive symptoms at age 3; therefore, if effects were to be found, they would need to emerge at age 5.

Analytic Approach

Hierarchical linear models (HLMs) were computed with the HLM 6.0 software package (Raudenbush, Byrk, Cheong, & Congdon, 2004). All cases with valid data at one or more time points were included. HLM assumes that data are missing at random, which implies that the observed data can predict missingness adequately at any given time point. That assumption is reasonable in this study because of random assignment and the capture of control variables at baseline, before random assignment.

Child cognitive ability, child aggression, maternal supportiveness, and the home learning environment were assessed initially when children were 2 years of age. Maternal depression was first assessed when children were 14 months of age. Follow-up measures of all five constructs were administered when children were 3 years old, and then again at age 5.

We used two-level models to generate growth curves for each outcome. Individuals constituted the units of analysis at level 2, and outcome scores at each time point constituted the units of analysis at level 1. Specifically, we modeled within-individual growth over time at level 1, as shown in Equation (1a). For four of the five outcomes (child cognitive ability, child

$$Y_{ti} = \beta_{0i} + \beta_{1i}(\text{Age in months}_{ti} - 11.1) + \beta_{2i}(\text{Age in months}_{ti} - 11.1)^2 + e_{ti} \quad (1a)$$

aggression, maternal supportiveness, and maternal depression), a quadratic term squaring age was found to be significant, indicating that growth was nonlinear over time. Thus, for those four outcomes, each individual *i*'s score on outcome variable *Y* at time *t* was modeled as a function of an intercept (β_{0i}), a linear age term (β_{1i}), a nonlinear quadratic age term (β_{2i}), and an error term (e_{ti}). For the home learning environment score (see Eq. 1b), which exhibited purely

$$Y_{ti} = \beta_{0i} + \beta_{1i}(\text{Age in months}_{ti} - 11.1) + e_{ti} \quad (1b)$$

linear growth over time, each individual *i*'s score on outcome variable *Y* at time *t* was modeled as a function of an intercept (β_{0i}), a linear age term (β_{1i}), and an error term (e_{ti}). In all models, the age variable was centered around its minimum value (11.1 months). Thus the level-1 intercept (β_{0i}) is interpreted as individual *i*'s score on outcome variable *Y* at the earliest age of assessment.

In level 2 models, time-invariant person-level characteristics were used to predict the intercept (β_{0i}) and linear slope (β_{1i}) terms from the level 1 models

(Equations 2a and 2b, respectively)

$$\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{EHS program group}) + \gamma_{02}(\text{Number of moves}) + \gamma_{03}(\text{Male child}) + \gamma_{04} \cdots \gamma_{06}(\text{Maternal education dummies}) + \gamma_{07} \cdots \gamma_{09}(\text{Race/ethnicity dummies}) + \gamma_{010} \cdots \gamma_{025}(\text{Site number dummies}) + u_{0i} \quad (2a)$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{EHS program group}) + \gamma_{12}(\text{Number of moves}) + \gamma_{13}(\text{Male child}) + \gamma_{14} \cdots \gamma_{16}(\text{Maternal education dummies}) + \gamma_{17} \cdots \gamma_{19}(\text{Race/ethnicity dummies}) + \gamma_{110} \cdots \gamma_{125}(\text{Site number dummies}) + u_{1i} \quad (2b)$$

$$\beta_{2i} = \gamma_{20} \quad (2c)$$

These characteristics included an indicator of EHS program status (1 = program group) as well as characteristics of the children and families at baseline entered as controls. To achieve model stability it was necessary to limit the controls to a select group of those used in the models of program impacts. Those selected fit two criteria: they were not redundant with other characteristics, and they may be hypothesized to moderate the effects of EHS, and so should be held constant. These characteristics included maternal education (9th–11th grade only, high school diploma/GED, and education beyond high school/GED versus less than 9th grade), race/ethnicity (African American, Hispanic, and other versus White), the number of times families moved during the year prior to the baseline, child male, and EHS site (16 dummy variables comparing sites 2–17 to site 1). All controls were grand-mean-centered.

Person-level predictors of the linear slope, if significant, may be thought of as interactions with time. For example, if EHS program status significantly predicted the linear slope, it would indicate an interaction between program status and time, such that the program and control groups had different rates of linear change. Person-level characteristics were excluded as predictors of the linear slope in the final level 2 model if they were not statistically significant in order to clarify the interpretation of main effects (the effects of those characteristics on the intercept, or score at initial assessment).

Level 2 equations predicting level-1 intercepts (β_{0i}) and linear slopes (β_{1i}) also included error terms (u_{0i} and u_{1i}; see Eqs. 2a and b). Because preliminary analyses failed to identify level-2 variability in nonlinear slopes (β_{2i}) for all five outcomes, equations predicting β_{2i} did not include level-2 predictors or error terms (see Eq. 2c).

The level-2 intercepts in Equations (2a–c) represent the parameters for an average growth curve when all level-2 predictors are set to zero (i.e., due to centering, its grand mean). In interpreting the level-2 program status indicators, γ_{01} represents the average effect of EHS on the level-1 intercept (i.e., the score at first assessment), and γ_{11} represents the average effect of EHS on linear growth in the level-1 outcome when the remaining level-2 predictors are set to zero.

We used an ITT approach to growth curve analysis due the capacities of the software program. As noted earlier in our previous tables, when the TOT estimates were compared with ITT-generated impacts in the original study, the results differ only in very minor ways.

Results

Growth in Children's Cognitive Skills

The Bayley MDI (Bayley, 1993) was used to measure cognitive ability at ages 2 and 3 but was no longer age-appropriate at age 5. We selected the Applied Problems subtest of the Woodcock-Johnson Test of Achievement (Woodcock & Johnson, 1990) to measure cognitive ability at age 5 because of all the age 5 measures, it is conceptually closest to the Bayley MDI. The level-1 model predicting cognitive ability therefore included a dummy variable to control for whether scores at each time t were based on the Bayley MDI or the Applied Problems subtest. Additional analyses substituting the PPVT-III as the measure of age 5 language skills produced comparable results.

As shown in Table 4, program status had a significant impact on children's cognitive ability at the initial age 2 assessment. The value of γ_{01} was 1.26 ($p < .01$), indicating that children in the program group scored 1.26 points higher on cognitive ability than children in the control group (with all controls set to their grand mean; ES = .08). Program status did not, however, impact linear or nonlinear growth. That is, the rate of change between ages 2 and 5 was the same for the program and control groups. Both experienced nonlinear change in cognitive ability (linear slope x2014;γ_{10}[SE] = 0.55[0.07], $t = 7.41$, $p < .001$; quadratic slope—γ_{20}[SE] = −0.01[0.00], $t = -6.78$, $p < .001$; Table 4 and Figure 2). In both groups, children's scores on cognitive ability increased between ages 2 and 3 (inflection point[7] = 35.96 months), but declined thereafter.

TABLE 4

GAMMA COEFFICIENTS, STANDARD ERRORS, AND *t*-RATIOS FOR HIERARCHICAL LINEAR MODELS PREDICTING SELECTED CHILD OUTCOMES OVER TIME

	Child's Cognitive Ability			Child's Aggression		
	γ	SE	*t*-Ratio	γ	SE	*t*-Ratio
Intercept (initial assessment)	82.76	0.90	92.02***	14.88	0.40	36.79***
Program group	1.26	.47	2.71**	−0.41	0.23	−1.78+
Mother completed 9th–11th grade	0.30	1.35	0.22	−0.57	0.44	−1.31
Mother completed HS/GED	2.77	1.43	1.94+	−0.56	0.46	−1.21
Mother went beyond HS/GED	4.43	1.46	3.04**	−1.43	0.47	−3.00**
African American	−4.48	0.78	−5.77***	1.84	0.60	3.06**
Hispanic	−3.71	0.94	−3.94***	0.47	0.71	0.67
Other race/ethnicity	−1.93	1.25	−1.55	−0.87	0.96	−0.91
Number of moves, past year	−0.61	0.23	−2.68**	0.44	0.11	3.92***
Male child	−2.33	0.47	−4.99***	1.17	0.23	5.10***
Site No. 2	3.08	2.58	1.19	0.89	1.28	0.69
Site No. 3	7.96	2.18	3.64**	0.05	1.12	0.04
Site No. 4	12.06	2.18	5.52***	−2.12	1.16	−1.83+
Site No. 5	6.08	2.19	2.78**	−1.43	1.13	−1.26
Site No. 6	12.73	1.92	6.65***	1.31	0.99	1.33
Site No. 7	−2.34	2.19	−1.07	2.85	1.15	2.48*
Site No. 8	−0.59	1.95	−0.30	0.15	1.00	0.15
Site No. 9	15.64	2.19	7.15***	−0.55	1.19	−0.46
Site No. 10	1.52	2.26	0.67	0.64	1.19	0.54
Site No. 11	11.41	2.01	5.69***	−1.24	1.07	−1.16
Site No. 12	−4.25	2.23	−1.91+	−1.22	1.17	−1.04
Site No. 13	8.44	1.89	4.46***	0.70	0.99	0.71
Site No. 14	2.04	2.12	0.97	−1.02	1.13	−0.90
Site No. 15	6.66	1.99	3.35**	0.33	1.05	0.32
Site No. 16	8.80	2.10	4.20***	2.11	1.14	1.86+
Site No. 17	−0.85	2.05	−0.42	−1.66	1.07	−1.55
Linear Slope	0.55	0.07	7.41***	−0.19	0.03	−7.09***
Program group	—	—	—	—	—	—
Mother completed 9th–11th grade	0.10	0.05	2.26*	—	—	—
Mother completed HS/GED	0.07	0.05	1.41	—	—	—
Mother went beyond HS/GED	0.16	0.05	3.20**	—	—	—
African American	—	—	—	−0.08	0.02	−5.12***
Hispanic	—	—	—	−0.05	0.02	−3.01**
Other race/ethnicity	—	—	—	−0.01	0.03	−0.55
Number of moves, past year	—	—	—	—	—	—
Male child	—	—	—	—	—	—
Site No. 2	0.22	0.09	2.51*	−0.00	0.03	−0.14
Site No. 3	−0.11	0.07	−1.64	−0.03	0.03	−1.18
Site No. 4	−0.16	0.07	−2.41*	0.02	0.03	0.69
Site No. 5	−0.19	0.07	−2.64**	−0.00	0.03	−0.05
Site No. 6	−0.17	0.06	−2.81**	−0.04	0.02	−1.75+
Site No. 7	0.08	0.07	1.14	−0.08	0.03	−2.66**

(*Continued*)

TABLE 4. (*Continued*)

	Child's Cognitive Ability			Child's Aggression		
	γ	SE	*t*-Ratio	γ	SE	*t*-Ratio
Site No. 8	−0.09	0.06	−1.49	0.00	0.03	0.19
Site No. 9	−0.23	0.07	−3.31**	−0.05	0.03	−1.55
Site No. 10	−0.01	0.07	−0.14	−0.04	0.03	−1.15
Site No. 11	−0.34	0.06	−5.52***	0.03	0.03	1.23
Site No. 12	0.06	0.07	0.90	0.02	0.03	0.55
Site No. 13	−0.03	0.06	−0.46	−0.04	0.02	−1.83+
Site No. 14	0.11	0.07	1.55	−0.02	0.03	−0.75
Site No. 15	−0.06	0.06	−0.96	−0.03	0.03	−1.33
Site No. 16	−0.39	0.07	−5.89***	−0.07	0.03	−2.51*
Site No. 17	−0.07	0.06	−2.15	0.02	0.03	0.73
Quadratic Slope	−0.01	0.00	−6.78***	0.00	0.00	5.74***

Note: $^{+}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Growth in Children's Aggressive Behavior

Children's aggressive behavior was reported by the mother at ages 2, 3, and 5 using the Aggressive Behavior scale from the CBCL (Achenbach & Rescorla, 2000). Program status had a marginally significant effect on children's aggressive behavior at the age 2 assessment (γ_{01}[SE] = −0.41 [0.23], $t = -1.78$, $p < .10$; Table 4), with children in the program group slightly less aggressive than children in the control group (ES = .06).

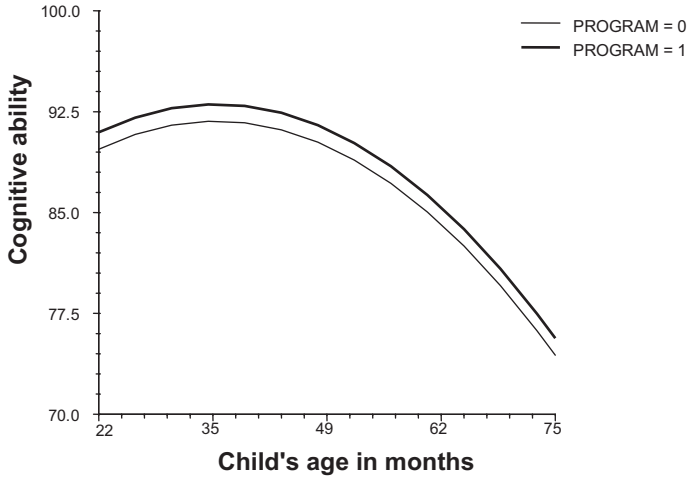

FIGURE 2.—Growth in child's cognitive ability.
Note: All level-2 covariates (number of moves, male child, race/ethnicity, maternal education, and site), and the level-1 dummy variable for the type of cognitive test administered, are set to grand means.

Program status did not have an effect on linear or nonlinear growth in aggression; thus, the difference between the program and control groups stayed constant over time. Both groups experienced nonlinear growth between ages 2 and 5 (linear slope—γ_{10}[SE] = −0.19[0.03], $t = -7.09$, $p < .001$; quadratic slope − γ_{20}[SE] = −0.00[0.00], $t = 5.74$, $p < .001$; Table 4 and Figure 3). In both groups, children's scores on aggression decreased from age 2 to age 4 and a half (inflection point = 52.97 months), but scores increased thereafter. However, aggression scores at age 5 did not exceed initial scores at age 2.

Growth in Maternal Supportiveness

Maternal supportiveness during play was assessed at child ages 2, 3, and 5 from the mother-child videotaped interaction. Program status had a significant impact on maternal supportiveness at age 2 (γ_{01}[SE] = 0.07 [0.03], $t = 2.28$, $p < .05$; Table 5). Specifically, mothers in the program group scored 0.07 points higher on supportiveness than did mothers in the control group (ES = .07). Program status did not impact linear or nonlinear growth; thus, the differential between the program and control groups remained constant through age 5. Identical patterns of nonlinear growth in supportiveness were found for mothers in both groups (linear slope—γ_{10}[SE] = −0.02[0.00], $t = -3.70$, $p < .001$; quadratic slope—γ_{20}[SE] = 0.00[0.00], $t = 3.59$, $p < .01$; Table 5 and Figure 4). In both groups, mothers' scores on supportiveness declined slightly after child age 2, but at approximately age 4, they began to increase slightly (inflection point = 45.98 months).

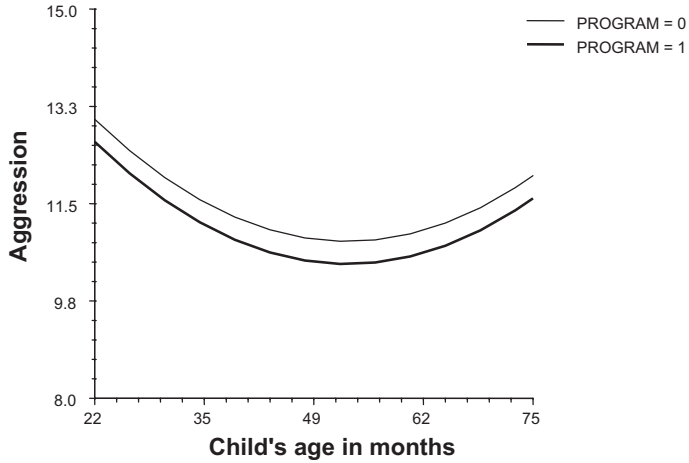

FIGURE 3.—Growth in child's aggression.
Note: All covariates (number of moves, male child, race/ethnicity, maternal education, and site) are set to grand means.

TABLE 5

GAMMA COEFFICIENTS, STANDARD ERRORS AND *t*-RATIOS FOR HIERARCHICAL LINEAR MODELS PREDICTING SELECTED MATERNAL OUTCOMES OVER TIME

	Maternal Supportiveness			Home Learning Environment			Maternal Depression		
	γ	SE	*t*-Ratio	γ	SE	*t*-Ratio	γ	SE	*t*-Ratio
Intercept (initial assessment)	4.15	0.06	63.94***	0.87	0.01	170.27***	9.13	0.20	46.07***
Program group	0.07	0.03	2.28*	0.02	0.00	3.36**	−0.23	0.22	−1.06
Mother completed 9th–11th grade	0.29	0.06	4.71***	0.06	0.01	7.20***	−0.19	0.42	−0.45
Mother completed high school/GED	0.50	0.06	7.67***	0.09	0.01	9.62***	−0.79	0.45	−1.76+
Mother went beyond high school/GED	0.77	0.07	11.58***	0.13	0.01	13.52***	−1.79	0.46	−3.91***
African-American	−0.33	0.09	−3.49**	−0.06	0.01	−8.16***	0.42	0.36	1.19
Hispanic	−0.28	0.11	−2.59*	−0.08	0.01	−8.07***	−1.35	0.43	−3.12**
Other race/ethnicity	−0.11	0.16	−0.71	−0.03	0.01	−2.79**	0.17	0.59	0.29
Number of moves, past year	0.01	0.02	0.88	−0.01	0.00	−2.68**	0.60	0.11	5.63***
Male child	−0.14	0.06	−2.52*	−0.01	0.00	−2.51*	0.12	0.22	0.54
Site No. 2	0.42	0.20	2.15*	−0.04	0.03	−1.53	−1.24	0.90	−1.38
Site No. 3	−0.05	0.17	−0.32	−0.00	0.02	−0.20	0.46	0.86	0.54
Site No. 4	0.41	0.18	2.34*	0.00	0.02	0.02	−0.90	0.88	−1.02
Site No. 5	0.09	0.17	0.53	−0.09	0.03	−2.98**	−0.88	0.85	−1.03
Site No. 6	0.16	0.16	0.99	0.02	0.02	0.77	−0.39	0.79	−0.50
Site No. 7	−0.23	0.18	−1.30	−0.04	0.03	−1.55	0.65	0.85	0.76
Site No. 8	−0.17	0.15	−1.13	−0.10	0.02	−4.37***	1.65	0.79	2.10*
Site No. 9	−0.18	0.19	−0.97	−0.04	0.03	−1.32	−2.24	0.88	−2.54*
Site No. 10	−0.05	0.18	−0.25	−0.03	0.03	−1.13	−0.96	0.90	−1.06
Site No. 11	−0.19	0.17	−1.15	0.00	0.03	0.12	1.11	0.82	1.35
Site No. 12	−0.14	−0.18	−0.75	−0.03	0.03	−0.98	−1.45	0.88	−1.65
Site No. 13	0.61	0.15	4.05***	0.01	0.02	0.28	0.19	0.78	0.24
Site No. 14	0.47	0.17	2.76**	0.08	0.03	3.24**	−0.62	0.84	−0.74
Site No. 15	0.23	0.16	1.41	0.02	0.03	0.92	0.41	0.82	0.50
Site No. 16	0.01	0.17	0.04	−0.14	0.02	−6.22***	−1.54	0.87	−1.77+

(*Continued*)

TABLE 5. (*Continued*)

	Maternal Supportiveness			Home Learning Environment			Maternal Depression		
	γ	SE	t-Ratio	γ	SE	t-Ratio	γ	SE	t-Ratio
Site No. 17	−0.41	0.17	−2.45*	−0.08	0.03	−2.81**	−2.56	0.83	−3.09**
Linear Slope	−0.02	0.00	−3.70***	−0.00	0.00	−13.23***	−0.06	0.01	−4.46***
Program group	—	—	—	—	—	—	—	—	—
Mother completed 9th–11th grade	—	—	—	—	—	—	—	—	—
Mother completed high school/GED	—	—	—	—	—	—	—	—	—
Mother went beyond high school/GED	—	—	—	—	—	—	—	—	—
African-American	0.00	0.00	1.52	—	—	—	—	—	—
Hispanic	0.01	0.00	2.63**	—	—	—	—	—	—
Other race/ethnicity	0.01	0.00	1.32	—	—	—	—	—	—
Number of moves, past year	—	—	—	—	—	—	—	—	—
Male child	0.00	0.00	2.18*	—	—	—	—	—	—
Site No. 2	−0.01	0.01	−1.24	0.01	0.00	7.14***	−0.07	0.02	−2.85**
Site No. 3	0.00	0.00	0.11	0.00	0.00	3.25**	−0.03	0.02	−1.29
Site No. 4	−0.01	0.00	−1.19	0.00	0.00	4.38***	0.01	0.02	0.50
Site No. 5	−0.00	0.00	−0.75	0.01	0.00	5.24***	−0.03	0.02	−1.11
Site No. 6	−0.00	0.00	−0.41	0.00	0.00	1.61	−0.01	0.02	−0.53
Site No. 7	0.00	0.01	0.28	0.00	0.00	1.01	−0.02	0.02	−1.03
Site No. 8	0.00	0.00	0.78	0.01	0.00	7.95***	0.01	0.02	0.34
Site No. 9	−0.00	0.00	−0.43	0.01	0.00	4.70***	0.03	0.02	1.52
Site No. 10	0.00	0.01	0.94	0.01	0.00	5.34***	−0.03	0.02	−1.11
Site No. 11	−0.00	0.00	−0.14	0.00	0.00	2.80**	−0.02	0.02	−0.75
Site No. 12	−0.00	0.00	−0.97	0.00	0.00	1.64	−0.01	0.02	−0.36
Site No. 13	−0.01	0.00	−2.13*	0.00	0.00	5.03***	0.01	0.02	0.66
Site No. 14	−0.00	0.00	−0.97	−0.00	0.00	−2.61**	−0.01	0.02	−0.56
Site No. 15	0.00	0.00	0.31	0.00	0.00	2.24*	−0.02	0.02	−1.15
Site No. 16	0.00	0.00	0.04	0.01	0.00	6.40***	0.00	0.02	0.18
Site No. 17	0.01	0.00	1.94+	0.00	0.00	4.16***	0.05	0.02	2.33*
Quadratic Slope	0.00	0.00	3.59**	—	—	—	0.00	0.00	3.30**

Note: +$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

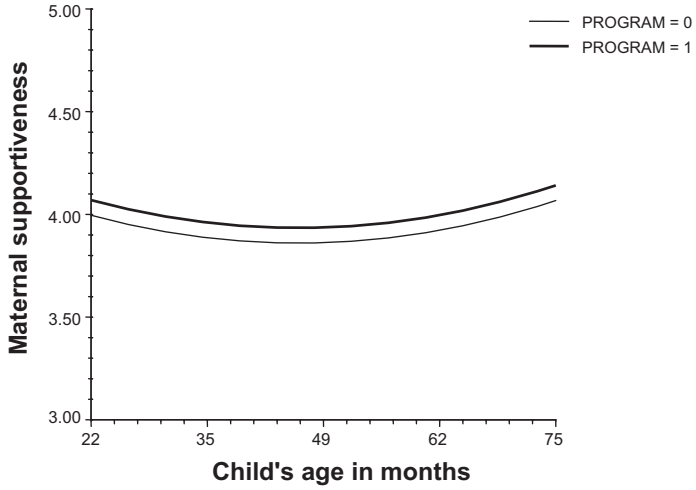

FIGURE 4.—Growth in maternal supportiveness.
Note: All covariates (number of moves, male child, race/ethnicity, maternal education, and site) are set to grand means.

Growth in the Home Language and Learning Environment

The quality of the home environment was measured at ages 2, 3, and 5 with a subscale of the HOME Inventory (Caldwell & Bradley, 1984; Fuligni et al., 2004). Because the number of items in the scale varied slightly across the three ages, scores at each time point were converted into proportions of the total possible score. Therefore, scores ranged from 0 to 1 ($M = .82$, $SD = .17$).

Program status had a significant impact on the home learning environment at the time of the age 2 assessment (γ_{01}[SE] = 0.02[0.00], $t = 3.36$, $p < .01$; see Table 5). Mothers in the program group scored 2 percentage points higher on the home learning environment than mothers in the control group (ES = .11). However, their rate of change between ages 2 and 5 was identical to that of mothers in the control group. Both groups experienced only linear growth over time. Scores decreased from age 2 to age 5 (linear slope—γ_{10}[SE] = −0.00[0.00], $t = -13.23$, $p < .001$; Table 5 and Figure 5).

Growth in Maternal Depression

At age 14 months, 3 years, and 5 years, mothers completed the CES-D scale (Radloff, 1977); at age 2, a different depression scale was administered, so we used the child age 14 months CES-D scores for this analysis. The long form was used at age 14 months (20 items) and the short form (12 items) at ages 3 and 5. To achieve consistency, we selected only the items from the age

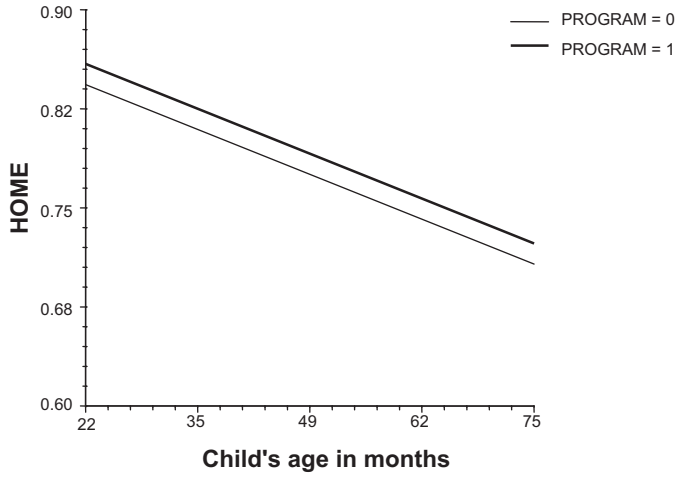

FIGURE 5.—Growth in home learning environment.
Note: All covariates (number of moves, male child, race/ethnicity, maternal education, and site) are set to grand means.

14 months form that appear in the short form for the present analyses (i.e., 12 items at each of the three ages).

Program status did not have a significant impact on maternal depression at the initial assessment at child age 14 months. Nor did program status have an effect on linear or nonlinear growth in maternal depression (Table 5 and Figure 6). Accordingly, growth curves, including intercept values, were identical, regardless of program status (linear slope—γ_{10}[SE] = −0.06[0.01], $t = -4.46$, $p < .001$; quadratic slope—γ_{20}[SE] = 0.00[0.00], $t = 3.30$, $p < .01$; Table 5 and Figure 6). Scores on maternal depression declined slightly after child age 14 months until child age 3 (inflection point = 38.30 months), when they started to increase slightly. Scores at age 5 resembled those at age 14 months.

MEDIATORS OF EHS PROGRAM IMPACTS AT AGE 5

Research Questions

If impacts are found at age 5, 2 years after the EHS program ended, it is likely that earlier effects account for sustained effects. Therefore, we conducted mediator analyses to investigate the extent to which impacts found earlier mediated or accounted for, at least in part, any impacts discovered later. A few previous evaluations of early childhood programs have reported such analysis. In one, based on the Abecedarian Project and Project

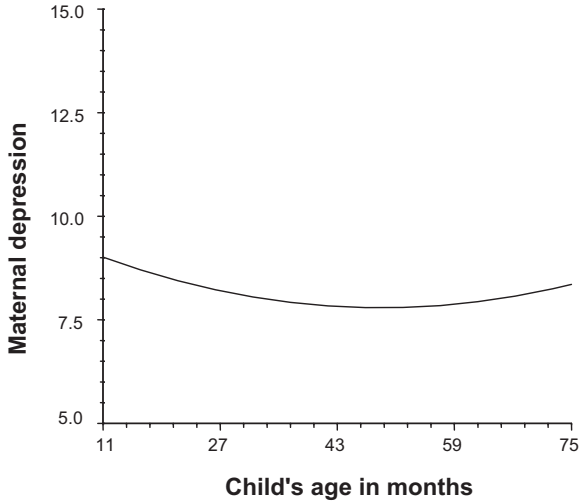

FIGURE 6.—Growth in maternal depression.
Note: All covariates (number of moves, male child, race/ethnicity, maternal education, and site) are set to grand means. Intercepts and slopes are identical for the program and control groups.

CARE, Burchinal, Campbell, Bryant, Wasik, and Ramey (1997) reported that sustained cognitive effects in childhood were in part due to program changes in infants' cognitive responsiveness. At the same time, the parenting behaviors measured (which were parental attitudes, not actually parenting behavior) were not influenced by the program and therefore could not have been operating as mediators. In the IHDP study, impacts on maternal depression when the children were 1 year of age influenced the later impact on behavior problems at age 3 (Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998). In the same intervention program, effects on parenting behavior mediated program effects on cognitive development (Linver, Brooks-Gunn, & Kohen, 1999).

Based on the small research base, we did not have differential expectations for how intermediate and end-of-program impacts would mediate later outcomes, so we focused on end-of-program impacts. We expected impacts at the end of the program to mediate longer term impacts in the following ways (keeping in mind that at age 5, program impacts were found for behavior and attention, but not for achievement test scores). First, early program effects on child's language and cognition would be likely to mediate later program impacts on attention. Second, parenting behaviors, measured here as HOME language and literacy support, were expected to mediate later program impacts as well (both behavior and attention). Third, reductions in aggressive behavior at age 3 were expected to mediate impacts on behavior and attention at age 5.

Analytic Approach

Analyses were conducted using Mplus4 software. To test for mediation, we followed a procedure outlined by Kenny, Kashy, & Bolger, 1998. They defined the amount of mediation as the reduction in the direct effect of the initial variable (in this case, EHS Program) impact on the outcome variable (in this case, the age 5 impact variable) when the mediator is added. They demonstrate that this amount of reduction is equal to the products of the coefficients of the paths comprising the indirect effect. Mplus4 provides two tests relevant to examining mediation in this way. The first is the total indirect effect, which is the cumulative mediated effect through all mediators included in the model. This test answers the question of whether all the included (impact) mediator variables, taken together, mediate the effect of Program on the age 5 (impact) dependent variable. The second type of test is called the specific indirect effect. This is a test of the significance of the mediation through each of the mediators individually, controlling for the other mediators in the model. These tests answer the question of whether individual variables emerge as significant mediators of the effect of program on the age 5 dependent variable. All reported parameter estimates are standardized. In the models, random assignment to the EHS condition (Program) predicts the mediators, and the mediators, in turn, predict the age 5 outcome. Each model also includes a direct path from Program to the age 5 dependent variable. These models also include a group of covariates. The resulting models have no available degrees of freedom and are only identified, so fit statistics were not calculated.

We selected the outcomes and mediators as follows. All child outcomes were from the social, emotional, attention, and approaches to learning domains, given that no overall impacts were found for the cognitive, language, and academic skill domains at age 5. The outcomes include FACES social behavior problems, observed attention from the Leiter Scale, and FACES approaches to learning. The mediators to be examined include earlier aggressive behavior and engagement with the mother during play as well as the Bayley MDI and PPVT-III, all assessed at age 3. The language and literacy environment of the home also was included.

Results

Observed Attention at Age 5

Four of the five age 3 mediators significantly predicted observed attention at age 5 (Figure 7). Engagement during play and Bayley MDI were positively associated with observed attention, and aggressive behavior was negatively associated with it. The total indirect effect was significant ($b = .10$, $t = -3.40$, $p < .001$), indicating that the four age 3 mediators, as a group, significantly

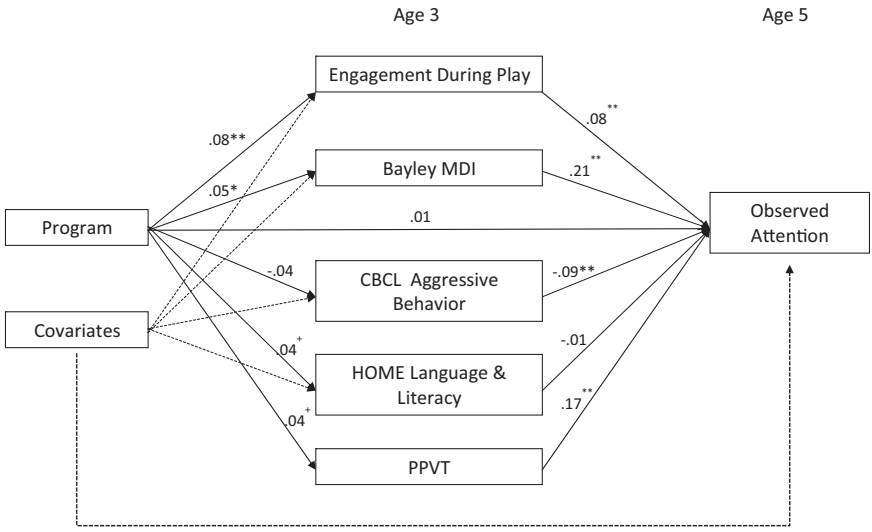

FIGURE 7.—Age 3 mediators of EHS impact on observed attention at age 5.
Note. All parameter estimates are standardized. Covariates include site, race/ethnicity, primary language at home, maternal education, whether child was first born, maternal employment status, living arrangement, number of children aged 0–5 in the household, number of children aged 6–17 in the household, child sex, whether the child was evaluated for concerns about health and development, whether the child was low birth weight, and whether the family received AFDC, food stamps, or WIC.

mediated the association between program and observed attention. There were two significant specific indirect effects (engagement during play: $b = .03$, $t = 2.44$, $p < .05$; and Bayley MDI: $b = .06$, $t = 2.42$, $p < .05$).

Approaches to Learning

Two of the four age 3 mediators significantly predicted FACES positive approaches to learning at age 5 (Figure 8). CBCL aggressive behavior was negatively associated with positive approaches to learning, whereas language and literacy in the home was positively associated with it. The total indirect effect was significant ($b = .04$, $t = 2.45$, $p < .05$), indicating that the group of four mediators significantly mediated the effect of EHS program on approaches to learning (Figure 8). There were no significant specific indirect effects. As with the model with age 2 mediators, the direct path from EHS program to approaches to learning was significant, indicated that the EHS Program had an impact on this outcome that was not mediated completely through the age 3 mediators.

Social Behavior Problems

Only one of the age 3 mediators, CBCL aggressive behavior, significantly predicted FACES social behavior problems (Figure 9). The total indirect

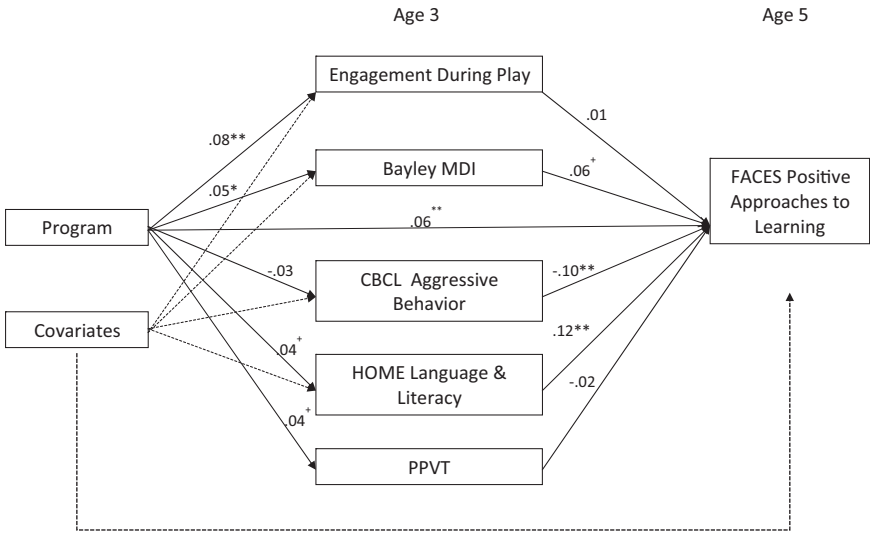

FIGURE 8.—Age 3 mediators of EHS impact on positive approaches to learning at age 5 (see Figure 7 note).

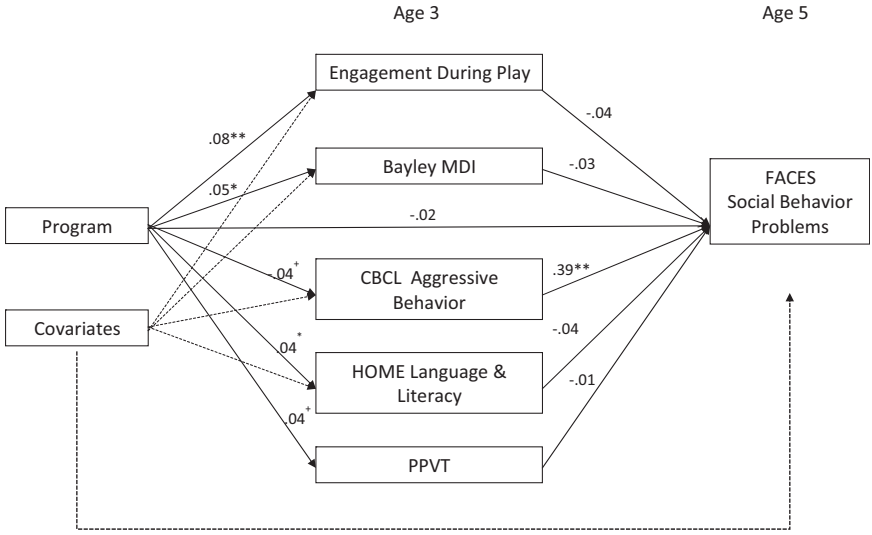

FIGURE 9.—Age 3 mediators of EHS impact on behavior problems at age 5 (see Figure 7 note).

effect of the mediators was significant and negative ($b = -.15$, $t = 2.37$, $p < .05$). None of the specific indirect effects was significant, but there was a trend for CBCL ($b = -.11$, $t = 1.75$, $p < .10$) to be a mediator.

DISCUSSION

The overall impacts suggest that the EHS program was effective in enhancing child, parent, and family outcomes at ages 2 and 3. The effects, although modest in size (with effect sizes of .15–.20), were found across a wide array of outcomes. In addition, the effects often appeared as early as age 2 and were for the most part maintained through age 3. At age 5, significant impacts continued to be seen for child social, emotional, attention, and approaches to learning outcomes. However, differences in vocabulary and achievement were not seen at age 5 (although Spanish-speaking 5-year-olds who participated in EHS had higher vocabulary scores than their control group counterparts). Parenting behaviors also were enhanced by the EHS program at age 2, with these effects, for the most part, being sustained at age 3 and some continued through age 5. Family well-being was enhanced at age 2, although these gains were not significant at age 3. By age 5, mothers in the EHS group had lower depression scores and were less likely to have someone in the household with an alcohol or drug problem. Furthermore, EHS was somewhat effective in getting children into formal program settings, including Head Start, following EHS, although more than half of the children were not in formal program continuously in the 2 years between EHS and kindergarten. As context for the impacts observed at age 5, we noted that EHS program participation had small (5–6 percentage points) but significant impacts on the percentage of children enrolled in formal early care and education programs, including Head Start, between ages 3 and 5.

The growth curve analyses indicate that the EHS program had a positive impact on four of the five potential outcomes considered here: child cognitive skills, child aggressive behavior, maternal supportiveness, and the home language and learning environment. By contrast, EHS had little impact on maternal depression in the growth curve analyses.

Notably, the results of growth curve analysis reveal a similar pattern for the four outcomes affected by EHS. First, the positive impacts of EHS appeared early; second, the magnitude of the impacts remained constant or diminished over the 3-year observation period. With respect to the first point, the current analyses show that EHS had a positive impact on children's cognitive ability and aggressive behavior, along with maternal supportiveness and the home learning environment, by the time children were 2 years old. By that age, families had participated in EHS for approximately 18 months, on

average. The current analysis shows that the differences in treatment and control families were similar over time (i.e., the growth curves for each did not converge, as would be expected if the treatment group become more like the control group, nor did they diverge, as would be expected if the treatment group became less like the control group). However, behavioral differences were seen at age 5, whereas cognitive ones were not in the cross-sectional analyses.

Although it is noteworthy that the program impacts did not diminish over time, neither did they increase. This was true when looking at the size of impacts during the program (ages 2 and 3) and after the program (age 5). These results are consistent with other effective early education programs, all of which have demonstrated steady or declining, but never increasing, impacts during or after the program ended (Barnett, 1995; Brooks-Gunn, 2004; Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001; Currie, 2001; Gray & Klaus, 1970; Karoly et al., 2005; Lee, Brooks-Gunn, Schnur, & Liaw, 1990; McCarton et al., 1997; Schweinhart, Barnes, & Weikart, 1993).

Other program evaluations also have not reported increases in impact effect sizes over the life of the intervention (in the few evaluations for which data at ages 2 and 3 exist). However, such an increase could theoretically appear because with several child outcomes, early differences between children widen over time. Higher performing children have a stronger base of knowledge and awareness into which new lessons are incorporated, and their early successes might increase their motivation (Knudsen, Heckman, Cameron, & Shonkoff, 2006).

It is especially noteworthy that the curves for the treatment and control groups did not converge. Other evaluations suggest that impacts decline by more than one-half of a standard deviation a few years after the program has ended (Anderson, 2008; Karoly et al., 2005); however, the earlier results are based on cross-sectional analyses, not growth curve analyses. It has been suggested that the effects of Head Start fade over time because its graduates go on to attend poor-quality schools that undermine gains from the program (Lee & Loeb, 1995). A similar process might also apply to EHS graduates. The formal early care and education arrangements children entered after EHS may not have been of sufficiently high quality to augment, rather than merely sustain, the gains made during the program. And, in the EHS sample, many families did not receive any services in the 4th and 5th year of the study, after the end of the program, also mitigating against sustained effects. In Chapter VI we report that the children who displayed the most optimal outcomes at age 5 were those who went on to attend a formal early care and education program after EHS.

Finally, it is worth noting that the growth curve analysis was limited by the available measures. Ideally, such analysis would be based on identical measures administered at all time points. In the current study, legitimate

concerns about age-appropriateness led to the use of a different assessment of children's cognitive ability at age 5 than at ages 2 and 3. Consequently, our analysis of children's growth in this area used two different tests, but we were able to compare them because they were scored on the same metric when standardized by national age norms. However, raw scores generally are preferred to standardized scores for the purposes of growth curve analysis. Unlike raw scores, which can be compared intuitively over time, standardized scores express children's achievement relative to those of their peers, thus limiting their interpretability over time.

The mediator analyses of the three child outcomes at age 5 were, for the most part, significant. For observed attention, the mediators accounted for all of the program impact, with children's earlier vocabulary, mental developmental index, and aggressive behavior accounting for the sustained effect. HOME language and literacy impacts at age 3 were not associated with a reduction in the EHS impact on observed attention at age 5. Reductions in children's aggression at age 3 accounted for the age 5 impacts on social behavior problems (while vocabulary, mental developmental index, and HOME language and literacy did not). Impacts on positive approaches to learning were accounted for, in part, by HOME language and literacy, as well as by earlier impacts on children's aggressive behavior.

NOTE

7. The inflection point is the value on the x-axis at which the curve bends.