Institute for Research on Poverty
Discussion Paper no. 1095-96

Extended Early Childhood Intervention and School Achievement: Age 13 Findings from the Chicago Longitudinal Study

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July 1996

Preparation of this paper was partially supported by Grant R29HD34294 from the National Institute of Child Health and Human Development.

Abstract

We evaluated the effects of participation in an extended program of compensatory education for a large sample of inner-city black children up to the seventh grade. The intervention is the Chicago Child-Parent Center and Expansion Program. Groups included 426 children who participated in the program from preschool to grades 2 or 3 and 133 school-stable children whose participation ceased in kindergarten. After taking into account initial differences in both the level and the growth rate of achievement, frequency of school mobility after the program, and sample selection bias, program participation for two or three years after preschool and kindergarten is positively associated with reading and math achievement in grade 7 and negatively associated with cumulative grade retention four years after the end of the program. Study findings provide rare longitudinal evidence from an established program concerning the effects of extending compensatory education into the primary grades.

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INTRODUCTION

In this study, the marginal effects on reading and math achievement and grade retention of participation in a follow-on intervention after kindergarten (from grades 1 to 3) are investigated for a sample of 559 inner-city black children from low-income families. The program is called the Chicago Child-Parent Center and Expansion Program (CPC Program). This federal- and state-funded program enrolls economically disadvantaged children from preschool to third grade, for a maximum of six years of enrollment. Data come from the Chicago Longitudinal Study, an ongoing investigation of the effects of extended early childhood intervention.[1]

Importantly, the effects of the follow-on program are estimated by incorporating multiple observations on pretreatment achievement. There is consensus across the social sciences (Berk, 1991; Cook & Shadish, 1994; Moffitt, 1991) that longitudinal evaluations of social programs should be emphasized. While large-scale analyses of the effectiveness of Head Start programs commonly do not incorporate pretreatment achievement measures (e.g., Barnow & Cain, 1977; Currie & Thomas, 1995), the current study estimates the effect of the follow-on program of compensatory education by taking into account differences between participants and nonparticipants in initial *levels* and *growth rates* of achievement. To estimate the added value of follow-on intervention, we report comparisons between children who participated in the extended program from preschool to grades 2 or 3 and similar children who enrolled in the preschool and kindergarten component of the program but did not complete the follow-on program offered in the primary grades.

Research Context

Although three decades of research have indicated that early childhood interventions of good quality improve children's cognitive development and school achievement in the short term and often enhance school competencies over the longer term (Consortium for Longitudinal Studies, 1983; Haskins, 1989; McKey et al., 1985), it is increasingly recognized that a one- or two-year program cannot immunize children against poor academic outcomes. This is especially true for large-scale, government-funded programs like Head Start that rely on limited human and financial resources to serve children and families most in need of services.

Understandably, the evidence for longer-term effects on children of large-scale established programs like Head Start is less strong than for researcher-initiated, well-funded model programs (Currie & Thomas, 1995; Barnett, 1992; Sawhill, 1992; Haskins, 1989.) The existing evidence suggests that, for many preschool programs, the estimated effects on children's cognitive and scholastic achievement tend to fade substantially by second or third grade. The cause of these findings is debatable and could be due to the quality of children's postprogram environments, the methodological quality of the studies, or to the quality of the programs themselves.

To promote better school success for economically disadvantaged children, educators and researchers are increasingly recommending that early childhood interventions last longer, preferably from preschool to third grade (National Head Start Association, 1990; Zigler & Styfco, 1993). Our study provides important evidence about this recommendation.

Importance of Extended Childhood Intervention

Better performance among children who participate in extended early childhood interventions from preschool to the primary grades can be expected for three major reasons. First, a longer implementation period may be necessary to promote greater and longer-lasting changes in academic and social outcomes. Many economically disadvantaged children need more time to gain all the

benefits the program has to provide. Early childhood interventions provide many services to children and parents (e.g., health, educational, parent-involvement activities) that require significant coordination and effort. Moreover, because the rate and negative consequences of poverty among young children is growing (Hernandez, 1994), existing programs may require expansion to be effective.

Second, developmental research overwhelmingly indicates that an important ingredient of normal cognitive and social functioning is the experience of a stable and predictable learning environment (Cole & Cole, 1993; Garmezy & Rutter, 1988). By giving children and their parents the opportunity to enroll in programs for up to five or six continuous years, the stability of the school learning environment may enhance school performance and social competence.

A third justification for extended childhood interventions is that the transition to formal schooling in kindergarten and first grade is a very sensitive—if not “critical”—period in children's scholastic development (Alexander & Entwisle, 1988; Entwisle & Alexander, 1993). The provision of additional educational and social support services to children and families during this key transition would be expected to promote better adjustment. Research on early schooling indicates that the initial adjustment to school has significant and substantial effects on later school success (Entwisle & Hayduk, 1988; Reynolds, 1991, 1992). Extended intervention programs are designed to promote better transitions through this important period.

Although the rationale for extending the program into the primary grades is well grounded in theory, there is little empirical evidence of the effectiveness of extended interventions. Although Project Follow Through was originally designed to provide extended intervention services for Head Start graduates, it was implemented as planned variations of different instructional models for children regardless of their participation in preschool intervention (Zigler & Styfco, 1993). While some early studies of children attending Head Start and Follow Through (Abelson, Zigler, & DeBlasi, 1974; Seitz, Apfel, Rosenbaum, & Zigler, 1983) and similar extended intervention programs (Fuerst & Fuerst,

1993; Jordon, Grallo, Deutsch, & Deutsch, 1985) showed that children who participated in extended intervention had higher school achievement than children who did not participate, most studies have not distinguished between the effects of duration and timing. To determine the effects of extended intervention, children must either be randomly assigned to preschool intervention and extended intervention groups or they must be investigated through natural variation in exposure to treatment.

Recent studies of the Carolina Abecedarian Project did separate the effects of preschool and follow-on programs through random assignment to treatment groups. Campbell and Ramey (1994, 1995) traced 93 children who participated to varying degrees in a model intervention in Chapel Hill, North Carolina, from birth to age 8. Investigators found that participation in the five-year preschool program was positively associated with higher cognitive ability and school achievement as well as lower grade retention and special education placement up to age 15. The three-year school-age program was found to have limited independent effect and was associated only with reading achievement at age 15. A unique feature of that project was the five-year duration of the preschool program. In recognition of the possible benefits of extended childhood interventions, the U.S. Department of Health and Human Services currently is funding the Head Start Transition Project (Zigler & Styfco, 1993). While it is still too early to ascertain the longer-term effects of the extended services offered through the Head Start Transition Project, important evidence is provided by the Chicago CPC Program.

Previous Findings from the CPC Program

Investigation of the CPC Program has been carried out prospectively in the Chicago Longitudinal Study (Reynolds, 1994; Reynolds & Bezruczko, 1993). Children began their participation in preschool and could continue to receive services through second or third grade. The longitudinal sample also includes several hundred children who received no services from the CPC Program but were enrolled in public schools in similar low-income neighborhoods.

Preschool effects. Previous studies of the preschool component of the program have indicated that participation is significantly associated with higher school achievement and lower incidence of grade retention (Reynolds, Mavrogenes, Bezruczko, & Hagemann, 1996; Reynolds, 1995; Reynolds & Temple, 1994). Reynolds (1995), for example, reported that preschool participation was significantly associated with higher reading and math achievement (about .30 standard deviations) in grade 6, well beyond the influence of child and family background characteristics. These findings have been reproduced with different samples and subgroups, alternative explanatory variables, and alternative methods of accounting for potential bias caused by nonrandom enrollment into the CPC Program. In particular, we found that the estimated effects on school achievement of preschool participation were robust across econometric two-stage techniques and psychometric latent-variable techniques (Reynolds & Temple 1995).

Follow-on/extended intervention effects. Reynolds (1994) investigated the relationship between the duration of participation in the CPC Program and child outcomes at the end of the program (grade 3) and at the two-year follow-up assessment (grade 5) for 1,106 black children. The duration of participation was significantly associated, in the expected direction, with reading achievement, mathematics achievement, and grade retention controlling for the influence of sociodemgraphic factors (i.e., sex, school socioeconomic status [SES] in kindergarten, parent education, eligibility for free lunch, and age). Analysis of seven intervention and comparison groups differentially exposed to the intervention revealed that participation in the follow-on intervention for two or three years significantly contributed more to children's adjustment (i.e., improved achievement, lowered incidence of grade retention) than preschool intervention after controlling for kindergarten achievement. Participation in extended intervention to second or third grade was associated with a six-month advantage in reading and math achievement and a 36 percent reduction in grade retention relative to participation in preschool and kindergarten. Findings were consistent across several analyses, including those utilizing a

school-stable comparison group and those by site. Findings also indicated that the effects of timing and duration of intervention varied by domain. Duration of intervention was more associated with reading and math achievement and grade retention than was timing of intervention.

Evaluating Longer-Term Effects

If extended early childhood interventions truly represent a better alternative to preschool or follow-on intervention alone, they should continue to have effects beyond the two-year interval reported above. Such findings would provide strong evidence that continuing intervention beyond preschool and kindergarten adds to the effects of earlier intervention. If effects of the follow-on program do not last beyond two years, then it could be concluded that extended programs do not yield lasting differences in academic performance. If so, then extended programs merely provide a short-term boost in performance.

A second issue is the extent to which observed differences in academic performance between groups are due to program participation rather than to student attributes related to the decision to enroll in the program or to differential experiences after the program. Selection on unobservable factors is difficult to rule out in quasi-experiments. Short of randomization, one approach is to remove or reduce bias in the research design phase prior to data analysis. This strategy may include matching individuals or groups on key variables, pretesting groups, obtaining multiple comparison groups, and implementing prospective time-series designs. This is the long-standing practice in psychological and educational research (Cook & Campbell, 1979; Cook & Shadish, 1994). Alternatively, attempts to obtain estimates of program impact may be undertaken in the statistical analysis phase of the research. By measuring and incorporating explanatory factors that correlate with both program participation and outcomes of participation, program effects can be estimated and potential unmeasurable factors taken into account. This is the most prevalent approach in economics and is implemented through simultaneous modeling techniques, such as two-stage nonlinear least squares and the Heckman sample selection method

(Heckman, 1979). In view of the lack of consensus about the best approach to measuring impact in quasi-experiments (Cook & Shadish, 1994; Winship & Mare, 1992), the current study explicitly attempts to control for potential selection bias through a combination of research design and statistical analysis strategies.

The Present Study

The present study investigates the effects of the CPC Program on children's school achievement up to seventh grade, four years after the end of the follow-on program component. Because the two-year follow-up study found that the effects of duration of participation were largest for reading achievement, math achievement, and grade retention, analyses will be restricted to these outcomes (see Reynolds & Temple, 1994, for analyses of other outcomes).

In a significant extension of previous efforts to ascertain program effectiveness, the current study includes in the analysis only those children who entered the CPC Program in preschool and graduated from the kindergarten program in 1986. Given that all the sample children were enrolled in the preschool and kindergarten component of the CPC Program, we seek to determine the effects of continued enrollment through grades 2 or 3. All children in the sample were eligible for intervention, resided in low-SES school neighborhoods, and participated in the program for at least two or three years (beginning at age 3). Thus, the study implements a planned variation approach to program impact (Rossi & Freeman, 1993).

In addition to restricting the sample to include only those children who participated in the CPC Program, the current research imposes an additional requirement for inclusion into the study sample. Because children who participated in the full CPC Program through grades 2 or 3 were necessarily children who remained in the same school over the length of the intervention, this study *excludes* from the sample any comparison-group child who changed schools more than once between kindergarten and the end of third grade. This exclusion was undertaken to enhance group comparability. High numbers of

school moves have been found in recent studies (General Accounting Office 1994 and Woods, Halfon, & Scarlata, 1993) to be associated with and perhaps even cause lower academic achievement. The GAO report emphasizes that the incidence of school mobility is especially great among low-income urban children. In an attempt to estimate the effect of enrollment in the follow-on component of the CPC Program, the exclusion of comparison-group children who moved more than once allows for a comparison between two groups of students who have more similar school-stable backgrounds.[2] To the extent that participation in the CPC Program induces school stability, this exclusion will generate conservative estimates of the effect of the follow-on program.

In an additional attempt to control for differences in observed and unobserved post-program experiences for children in the follow-on and comparison groups, the number of school moves (ranging from zero to four) from third grade to seventh grade is included as an additional explanatory variable in estimating the longer-term effects of extended childhood intervention. The major question is: Does participation in extended childhood intervention from preschool to second or third grade enhance school adjustment at age 13 to a greater extent than participation in less extensive interventions?

METHODS

Design and Sample

The Chicago Longitudinal Study (Reynolds, 1994; Reynolds & Bezruczko, 1993) traces the school performance of 1,539 children who graduated from government-funded kindergarten programs in 1986 in the Chicago Public Schools. The sample used in the current research includes only the 559 children who participated in at least the CPC preschool and kindergarten programs in twenty centers and who were active in the school system in grades 3 (1989) and 7 (1993).[3] Most children (426 of 559) also participated up to three years in the follow-on program from grades 1 through 3. Restricting the analysis to only those students who participated in the preschool and kindergarten components allows

for an investigation of the effects of the follow-on program within a fairly homogeneous sample of children. Because all children in the current sample participated in some components of the CPC Program, selection bias related to initial motivation to enroll is removed. (See Reynolds [1994] for a detailed description of the total sample.)

The effects of extended intervention are based on comparisons of two groups. One group (the comparison or nonfollow-on group) included 133 children who participated in only the preschool and kindergarten components. These children are compared to 426 children who participated in the preschool and kindergarten program plus the follow-on program for two or three years (grades 1–3). These children are considered the full intervention group. Two hundred eighty-one (281) children participated for two years and 155 participated for three years. Frequent school movers from kindergarten through third grade are excluded from the comparison group in an attempt to generate a comparison group that more closely resembles the follow-on group. The comparison-group students necessarily moved once when they left the CPC Program after kindergarten or first grade. To obtain a conceptually distinct comparison group, 58 children who participated in the follow-on program for one year were also excluded.

Sample children are among the most disadvantaged in the Chicago school system. In their kindergarten year, the children attended CPCs located in schools in which 66 percent of the families were low-income or poor, compared to 42 percent for all elementary schools in Chicago. The schools attended by the children after the end of the follow-on program in grade 7 also appear to be substantially more disadvantaged than the typical school in Chicago. In the schools attended by the study sample in 1992, 84 percent of families were low-income compared to 65 percent for other city schools. In 1992, the study children attended schools in which the typical racial composition was 73 percent black, 18 percent Hispanic, and 8 percent white, compared with 50 percent, 29 percent, and 16 percent, respectively, for other Chicago K–8 schools.

Program selection. Entry into CPC Programs requires residency in school neighborhoods eligible for Elementary and Secondary Education Act (ESEA) Chapter I services, and applicants are accepted on a most-in-need basis. All children were eligible for intervention services due to economic and educational disadvantage. The existence of excess demand for the CPC Program means that many eligible students were turned away. Parents voluntarily enrolled their child into the program, for which parental involvement in kindergarten and preschool was required and was strongly encouraged in the follow-on program. Variation in exposure to intervention is due to a variety of reasons including family preferences, administrative differences across schools, and student or family mobility. School personnel report that some families enter their children in the CPC preschool and kindergarten with the expectation that they will leave the program after kindergarten to enroll in a more conveniently located grade school. Most of the students participated in the CPCs for the complete number of years that the services were offered to them. For administrative reasons unrelated to individual child attributes, fourteen of the schools in the sample offered the follow-on program through grade 2 while six schools offered the program through grade 3. Hence the possibility that unmeasured student attributes are responsible for the observed differences in outcomes between those students with two versus three years of follow-on experience is unlikely. Although participation in the CPCs is expected to induce greater school stability, differences in school mobility patterns for those students who had varying levels of follow-on participation will be taken into account.

Child Parent Center and Expansion Program

In 1967, the federal government provided Title I funds for eleven Child-Parent Centers in the Chicago Public Schools for economically and educationally disadvantaged children. At present, twenty-four centers throughout the city are funded through federal block grants and the state of Illinois. The program provides for half-day preschool, half-day or all-day kindergarten, and all-day service in the

follow-on program in the primary grades. Unlike most other early childhood programs, the CPC Program provides preschool, kindergarten, and follow-on services through grade 3 for up to six years of intervention. It emphasizes three major features: the provision of comprehensive services, parental involvement in school, and a child-centered focus on reading/literacy skills (see Chicago Public Schools, 1985, 1987; Conrad & Eash, 1983; and Reynolds, 1994, for implementation history).

The comprehensive services include (a) attending to children's nutritional and health needs (i.e., free breakfasts and lunches, and health screening), (b) coordinated adult supervision from a CPC head teacher, a parent-resource teacher, a school-community representative, and a teacher aide for each class, (c) funds for in-service teacher training in child development as well as instructional supplies, and (d) emphasis on reading and language development. The parent-resource teacher organizes the parent-resource room, which is designed to initiate education activities for parents as well as to foster parent-child interactions. The school-community representative monitors parental and child school involvement and, if necessary, visits families at home.

A main philosophy of the program is that parental involvement is the critical socializing force in children's development. At least a half day per week of parental involvement in the center is required during preschool and kindergarten, while parental involvement in the follow-on program is strongly encouraged. Parent involvement includes volunteering as a classroom aide to tutor children, accompanying classes on field trips, interacting with other parents in the center's parent-resource room, participating in reading groups with other parents, attending school meetings and programs, doing craft projects for use in the school or at home, and taking trips to the library with teachers and/or their children. Schools also frequently sponsor night courses for parents to obtain additional education, including their high school equivalency certificates. In the primary grades, the head teacher and parent-resource teacher are combined into one position (the curriculum parent-resource teacher).

The smaller class sizes and greater number of adult supervisors allow more individualized and child-centered attention in order to develop reading comprehension and writing skills. The children learn to read and write through small-group activities, shared reading, and journal writing. Moreover, classes go on field trips to places including the Museum of Science and Industry and the zoo. Monthly in-service teacher training sessions conducted by the Bureau of Early Childhood reinforce the emphasis on child-centered activities. Average class sizes for the preschool component are seventeen, with an adult-to-child ratio of 1 to 7. For the kindergarten and primary grade components, average class sizes are twenty-five, with adult-to-child ratios of 1 to 11.

Outcome Measures

School achievement in grades 3 and 7. Reading comprehension and overall mathematics test scores from the Iowa Tests of Basis Skills (ITBS) will be used as outcome variables. These test scores have demonstrated high reliability and predictive validity (Hieronymous & Hoover, 1990). Normed in 1988, the ITBS is group-administered each year in April by the Chicago Public Schools. Scores are reported in ITBS standard scores, which may be compared across test levels to determine cognitive growth from year to year. Scores range from 40 to 260. The national average in third grade for reading and math is 108 and 108, respectively, and in seventh grade, 155 and 156, respectively.

Grade retention. Grade retention was included as an additional outcome measure to investigate program effectiveness. Obtained from school records, grade retention was defined as a cumulative and dichotomous measure. Children were coded 1 if they were ever retained in a grade from kindergarten to grade 7 or if they were not at the grade level of their same-age peers (grade 8) in September 1993. Children were coded 0 if they were on grade level (grade 8) at the beginning of the 1993–94 school year.

Explanatory Measures

Table 1 provides descriptive data on family, child, and school variables used as explanatory variables or covariates in the analysis of program effects. These included student gender, family SES (based on eligibility for a lunch subsidy where family SES = 1 for full subsidy and 0 for a partial subsidy or no subsidy), and parent education (coded as 1 for at least high school graduate and 0 otherwise). These indicators were obtained from parent surveys and telephone interviews in grades 2 and 4. Because roughly one-fourth of the CPC students had parents who did not provide information to the CPC Program on family SES or parent education, a dummy variable was also constructed to represent whether or not the data on family SES and parent education were missing. If information on those two variables is missing, then the missing values were filled in with the lowest value for the available data and the dummy variable for missing information was set equal to one in an attempt to control for differences between students who had complete data in their records and those who did not.

In an attempt to control for school-level differences across CPC sites, a variable representing the school poverty rate in the students' CPC school was incorporated into the analysis as a possible factor influencing student achievement. A comparison of the group means reveals that students in the follow-on group and the comparison group enrolled in schools with similar percentages of low-income families.

Also included as explanatory factors were end-of-kindergarten pretest scores in reading (word analysis) and math achievement as measured by the ITBS kindergarten battery. Growth in kindergarten achievement was measured as the change in test scores from the beginning of

TABLE 1
Descriptive Statistics for Explanatory Variables

	Follow-on group	Comparison group
Female	0.53	0.56
Family low-income (1 = full lunch subsidy)	0.86	0.87
Parent education (1 = high school graduate)	0.46	0.43
Missing information (1 = missing family background information)	0.26	0.23
School poverty rate	66.38*	62.67
Mathematics achievement at end of kindergarten	60.74*	55.53
Unadjusted/adjusted group difference:	5.2/3.7	
Reading achievement at end of kindergarten	63.47*	59.50
Unadjusted/adjusted group difference:	4.0/2.7	
Achievement growth during kindergarten	19.56	18.18
Moves from Grades 3–7 *	0.63*	0.81
N	426	133

Notes: Follow-on group includes those students who participated in the full program through second or third grade. Follow-on comparison group includes students who participated in the CPC Program during preschool and kindergarten only.

*Indicates that differences between groups are significant at the 5 percent level.

kindergarten to the end of kindergarten. Finally, school mobility from grades 3–7 was the number of postprogram school changes.

Group Comparisons

An important feature of our data set is the availability of achievement measures obtained before the students entered the follow-on program. An obvious problem in estimating the effects of educational treatments with nonrandomized or quasi-experimental data is the difficulty of controlling for differences between groups in characteristics that may be correlated with both program enrollment and achievement. Studies of the effectiveness of compensatory education programs often attempt to control for existing socioeconomic differences between participants and nonparticipants without having available any data on pretreatment achievement. In this study, however, we have information on individual student achievement measured in two different periods before the students enter the follow-on program. The importance of having multiple pretreatment observations on outcomes has recently been emphasized by Moffitt (1991). The existence of achievement test scores measured both at the beginning and the end of kindergarten allows us to control for the initial level of achievement as well as the initial trend in achievement growth. Potentially, holding the initial level of achievement constant may not be sufficient for generating accurate estimates of the treatment effect if the two groups of students also differ with respect to achievement *growth*.

Table 1 reveals that students who enrolled in the full follow-on program through second or third grade tested significantly higher in both reading and math at the end of kindergarten. An analysis of the determinants of this difference reveals that part of the between-group difference in test scores is due to the explanatory variables, including growth in kindergarten achievement, parent education, and family low income. Taken together, the variation in the observed attributes between groups accounts for a significant portion of the observed differences in kindergarten achievement. In the case of reading, the adjusted mean difference between the follow-on and the comparison group is only 2.7 points instead of

4.0. The adjusted mean difference for the math test taken at the end of kindergarten is 3.7, while the unadjusted mean difference is 5.2.

Because the students who were to become the follow-on group were testing slightly better at the end of kindergarten than were the students who were about to become the comparison group, it is crucial that the estimates of effects of the follow-on program are obtained by including these end-of-kindergarten pretests in order to control for student attributes that are correlated with follow-on participation as well as subsequent academic achievement. Interestingly, the comparison of achievement growth over the kindergarten year reveals no significant differences in test score changes for the two groups. The scores indicate that the follow-on group exhibits greater cognitive achievement before entering the follow-on program, but that group's growth in achievement before program entry was not significantly different from the growth for the comparison group.

Table 1 also shows that the two groups differ significantly with respect to the number of school moves made by students after grade 3. To the extent that postprogram experiences for students may be different across groups and that these experiences (here, school moves) may be correlated with achievement, controlling for postprogram mobility in estimating the effect of the follow-on program on grade 7 achievement helps generate more accurate estimates of program effectiveness. Although not shown, groups were similar in family structure, as about 75 percent of children in the intervention and comparison groups live in single-parent families. Groups were also similar in the number of siblings and age at kindergarten entry. Previous studies using this data set have shown that neither the family structure variable nor the siblings variable is correlated with student achievement.

Analytic Strategy

We report several analyses of the relationship between participation in the CPC follow-on program and later academic outcomes. First, we investigate the effects of participation in the follow-on program through second or third grade by using a comparison group that had no participation beyond

kindergarten. Second, we estimate the added effect of the third year of follow-on for a smaller sample of the students who participated in the full amount of the program offered to them. As described earlier, many of the students enrolled in CPCs that offered the extended program through grade 2, while students in other neighborhoods enrolled in CPC schools that offered the program through grade 3. This administrative feature of the program offers a natural experiment for estimating the effects of extending the CPC Program by one year.

Importantly, the estimates reported in this study correct for a censoring or sample selection problem that is common in longitudinal analyses when there is attrition from the original sample. To be included in this longitudinal study that takes place over a number of years, individuals must have valid test scores in grades 3 and 7. The possibility of nonrandom attrition is addressed by using a two-equation simultaneous estimation method that takes into account both measurable and unmeasurable differences between individuals who remain in the sample through seventh grade versus those who do not. Correcting for sample selection is important because if an unobserved variable is correlated with both the probability of being in the sample and the academic outcomes of achievement and/or retention, then ordinary least squares regression would generate biased estimates of the effects of the follow-on program. The sample selection correction method used here is a maximum likelihood version of Heckman's (1979) correction technique commonly incorporated into econometric analyses and increasingly used across the social sciences (e.g., Reynolds, Mehana, & Temple, 1995.)

The equations used to estimated the effects of the follow-on program on reading and mathematics achievement in grades 3 and 7 and grade retention include a value-added specification in which a student's achievement on a previous test is used as an explanatory variable:

(1) $$A = a_1 + a_2F + a_3X + a_4A_K + e$$

where A includes the outcomes of mathematics and reading achievement in grades 3 and 7, as well as a measure of grade retention as of grade 7. There are five of these equations—one for each outcome. The

program variable F represents participation in the follow-on program (F=0,1), X is a vector of individuals, family, and school-level variables hypothesized to influence student achievement, and A_K is a measure of achievement at the end of kindergarten. Included in X is a variable $A_K - A_{K-1}$, which is a measure of test score growth from the beginning to the end of kindergarten.

The equations above can be estimated only for individuals who have valid test scores in grades 3 and 7. Moreover, the equations above are estimated only for individuals who have completed the follow-on program or for those who have had zero participation beyond kindergarten. Students who had partial participation for one year are not included. As of result of the sample censoring for missing test scores and for incomplete participation in the program, a larger sample of 776 individuals is reduced to 559. To control for the possible biases that the nonrandom sample selection might otherwise introduce, the equation above is estimated simultaneously for each of the five outcomes with another equation for sample selection.

In addressing sample selection, we employ a model where for each outcome a bivariate classical regression applies to the equation above along with another equation shown below as equation (2).

(2) $$z^* = aV + u.$$

Equation (2) is the sample selection equation. The error terms e and u are assumed to have a bivariate normal distribution, and the correlation between e and u is allowed to be nonzero. The latent variable z* represents the individual student's probability of being included in the sample that is used to estimate equation (1). We do not observe Z*, but we do observe whether or not a student is in the sample. Hence Z*'s observed counterpart Z is determined by: z=1 if $Z^* > 0$, and z=0 if $Z^* \leq 0$. As a result, equation (2) can be estimated as a probit equation where the observed dependent variable is equal to 1 if the student will be included in the outcome regressions, and the dependent variable is equal to 0 if the student will not be included. Although not shown in the results section, the probit equations for sample retention

include all of the covariates included in the estimation of equation (1), as well as additional site variables that we use to identify the model.[4]

RESULTS

Table 2 shows the group means for the achievement outcomes measured in April in grades 3 and 7. Students who participated in the full amount of the compensatory program through second or third grade clearly outperform the students whose participation in the CPC Program ended after kindergarten. Also displayed are the Chicago and national averages for the ITBS taken by third- and seventh-grade students. Although students in the study come from the poorest neighborhoods in Chicago, the follow-on group performed better than the average Chicago student in both reading and math in grades 3. The grade 7 test scores of the follow-on group were just below the citywide average. Participants in the CPC Program from preschool through kindergarten scored approximately at the Chicago average only in grade 3.[5]

In Table 3, we provide estimates of equation (1). For each of the five outcomes, the outcome equation (1) is estimated jointly with a probit equation for sample selection. This method of estimation can generate consistent and efficient estimates of program effects in the presence of nonrandom selection into (or out of) the sample. Importantly, the effects of participation in the program are estimated controlling for factors that may be correlated with participation in the follow-on program and with the outcomes. In estimating the effects of the follow-on program for reading and mathematics and grade retention, we control for both the level and growth of preprogram achievement.

TABLE 2
Descriptive Statistics for ITBS scores and Grade Retention

Intervention Group	*Grade 3 Achievement (age 9)* Reading	Math	*Grade 7 Achievement (age 13)* Reading	Math	*Percentage Ever Retained in Grade*
Extended intervention group (preschool + kind. + follow-on)	101.0 (3.3)	103.9 (3.5)	142.7 (6.7)	143.6 (6.8)	13.1
Comparison intervention group (preschool + kind. only)	93.7 (2.8)	98.6 (3.1)	136.9 (6.3)	137.8 (6.2)	30.1
Chicago average	95.0 (2.9)	100.0 (3.2)	146.0 (7.0)	145.0 (6.9)	—
National average	108.0 (3.8)	108.0 (3.8)	155.0 (7.8)	156.0 (7.8)	—

Note: Values in parentheses are grade equivalents. Ns for extended and comparison intervention groups are, respectively, 426 and 133. ITBS = Iowa Tests of Basic Skills (1988 norms). Standard deviations of standard scores for the extended intervention group are, respectively, 15.8, 12.4, 19.8, and 17.0. Standard deviations for the comparison group are, respectively, 17.0, 13.9, 20.5, and 17.8.

TABLE 3
Maximum Likelihood Estimation of the Effects of the Follow-on Program on Achievement in Grades 3 and 7and Grade Retention

	Math 3	Reading 3	Math 7	Reading 7	Grade Retention
Follow-on program (through second or third grade)	4.03 (0.01)*	6.52 (0.00)*	4.50 (0.03)*	6.43 (0.00)*	-0.136 (0.02)*
Female	1.45 (0.11)	4.50 (0.00)*	3.11 (0.01)*	4.82 (0.00)*	-0.120 (0.00)*
Family low-income (1 = full lunch subsidy)	-0.59 (0.71)	-0.38 (0.86)	-2.00 (0.33)	-3.04 (0.25)	0.081 (0.21)
Parent education (1 = high school graduates)	3.79 (0.00)*	3.48 (0.01)*	4.54 (0.00)*	4.03 (0.03)*	-0.059 (0.12)
Missing information (1 = missing family background)	-1.30 (0.38)	-2.08 (0.28)	-5.36 (0.00)*	-8.28 (0.00)*	0.029 (0.60)
School poverty rate	0.02 (0.64)	0.01 (0.93)	0.04 (0.52)	0.07 (0.42)	0.011 (0.56)
Mathematics achievement at end of kindergarten	0.31 (0.00)*	0.31 (0.00)*	0.40 (0.00)*	0.41 (0.00)*	-0.004 (0.00)*
Reading achievement at end of kindergarten	0.36 (0.00)*	0.50 (0.00)*	0.45 (0.00)*	0.50 (0.00)*	-0.005 (0.00)*
Achievement growth during kindergarten	-0.25 (0.00)*	-0.32 (0.00)*	-0.39 (0.00)*	-0.42 (0.00)*	0.003 (0.09)#
Constant	58.45 (0.00)*	45.44 (0.00)*	90.25 (0.00)*	83.20 (0.00)*	0.715 (0.00)*
Moves from grades 3–7	—	—	-2.35 (0.01)*	-3.36 (0.00)*	0.015 (0.58)
Correlation in errors between sample retention and outcome equations	0.36 (0.08)#	0.43 (0.02)*	0.42 (0.05)*	0.66 (0.00)*	-0.06 (0.86)

Notes: N=559 for each equation. Significance levels for a two-tailed test are in parentheses. Follow-on is coded 1 for students who participated in the program through second or third grade; 0 for students who participated through kindergarten only. Estimates shown here are obtained from jointly estimating an equation for sample selection along with each outcome equation using maximum likelihood estimation to control for nonrandom attrition from the larger sample of 776.

Grade 3 School Achievement

Enrollment in extended intervention (preschool to grades 2 or 3) was strongly associated with higher test scores in reading and math in grade 3. These results are obtained even after controlling for initial achievement at the end of kindergarten, achievement growth, nonrandom sample attrition, and other child and family variables. Holding other factors constant, students who participated in the follow-on program for either two or three years scored 4.0 points higher on the math test and 6.5 points higher on the reading test than the students who left the CPC Program after kindergarten. These findings are not surprising, given the earlier discussion of the commonly found short-term effects of compensatory education programs. These differences correspond to effect sizes of .40 and .31, respectively, in reading and math. The effect sizes are proportions of standard deviations and were calculated as the metric regression coefficient divided by the pooled standard deviation of school achievement.

Notably, kindergarten pretest scores in reading and math as well as achievement growth in kindergarten were significantly associated with school achievement in grade 3. Interestingly, growth in kindergarten achievement was negatively associated with school achievement. Children exhibiting little achievement growth prior to the follow-on program were more likely to have higher test scores. This trend may reflect regression toward the mean. The positive and generally significant cross-equation correlation between sample retention and each child outcome indicates that children who remained in the sample after kindergarten through grade 7 performed better in grades 3 and 7 than the other students would have performed if they had remained in the sample. Taking this into account gives more accurate estimates of program effects.

Grade 7 School Achievement

In Table 3, the columns labeled Math 7 and Reading 7 provide evidence on the longer-term effects of the follow-on program. Participation in the follow-on program is found to have a significant

positive relationship with school achievement in reading and math four to five years postprogram. Participation in extended intervention was associated with a 6.4-point advantage in reading achievement and a 4.5-point advantage in math. These translate into effect sizes of .32 and .26, respectively. Although these effect sizes are slightly lower than those at third grade, they represent a five-month advantage in performance.

Taking advantage of the richness of the data, we find that this positive relationship remains even after controlling for the mobility of students in the years after the follow-on program. In the years between grade 3 and grade 7, the students in the sample moved from zero to four times. Because students in the comparison group moved more frequently and also performed worse than the follow-on group on the grade 7 tests, controlling for student mobility after the end of the program is useful because it generates an estimate of the effectiveness of the program by comparing follow-on and comparison group students who had similar school mobility histories. Controlling for mobility is important for two reasons. First, a high number of school moves may have a direct negative effect on individual achievement growth. Second, controlling for mobility provides an indirect way of controlling for otherwise unobservable student or family attributes that are correlated with mobility and may affect achievement growth. To the extent that participation in the follow-on program induces greater postprogram school stability, the estimated positive and significant coefficients on follow-on in the grade 7 equations represent conservative estimates of the effects of the follow-on program.

Cumulative Grade Retention

As with school achievement, children participating in extended intervention were significantly less likely to be retained by eighth grade, even after taking into account group differences in many important factors including kindergarten pretest scores and the never-before utilized indicators of pre-follow-on growth in achievement, postprogram school mobility, and attrition. In Table 3, the maximum likelihood probit coefficients are converted to standard regression coefficients. Participation in

extended intervention was associated with a 13.6 percentage-point decline in cumulative grade retention. This represents a 45 percent reduction in the rate of grade retention between groups (30.1 percent versus 16.5 percent).

As with achievement, kindergarten achievement and achievement growth were significantly associated with cumulative grade retention. Girls were less likely to be retained in grade than boys. Postprogram school mobility was unrelated to grade retention, ceteris paribus.

Alternative Estimates

In Table 4, alternative estimates of the follow-on program are presented which are derived using different specifications of the follow-on variable. To save space, the estimated coefficients of the other explanatory variables are not shown. In specification I, the effects of different levels of program exposure are estimated using a dummy variable equal to one for students who had exactly two years of follow-on and another dummy variable equal to one for students who had three years of the program. The coefficients represent the effect of enrolling for two years instead of zero, and for enrolling in three years instead of zero. Results provide evidence of longer-term positive effects on student achievement of participation of the preschool plus follow-on program. The effects of two years of participation were significant for grade 7 reading achievement (4.3-point advantage over the nonfollow-on group) and cumulative grade retention (11 percentage-point advantage over the nonfollow-on group) but not for grade 3 outcomes. The effects of three years of follow-on intervention after preschool and kindergarten were consistently significant over time for all outcomes. Participation was associated with a 10.4-point advantage in grade 7 reading, a 6.5-point advantage in grade 7 math, and a 20 percentage-point reduction in grade retention.

Specification II more directly estimates the *marginal* effect of extending the follow-on program into the third grade. The grade 3 results suggest that the students who had just completed the third year of the program perform better on the tests that they take at the end of third grade. More

TABLE 4

Alternative Maximum Likelihood Estimates of the Effect of the Follow-on Program

	Math 3	Reading 3	Math 7	Reading 7	Grade Retention
Specification I					
Follow-on program through second grade only	1.51 (0.28)	2.74 (0.13)	3.04 (0.14)	4.29 (0.04)*	-0.11 (0.03)*
Follow-on program through third grade	7.82 (0.00)*	11.02 (0.00)*	6.47 (0.02)*	10.40 (0.00)*	-0.20 (0.00)*
Specification II					
Follow-on through at least second grade	1.51 (0.28)	2.73 (0.13)	3.07 (0.13)	4.29 (0.04)*	-0.11 (0.03)*
Follow-on through third grade	6.31 (0.00)*	8.29 (0.00)*	3.44 (0.06)#	6.11 (0.00)*	-0.10 (0.04)*

Notes: N=559. Significance levels for two-tailed t-tests are in parentheses. Presented are coefficient estimates for alternative formulations of the follow-on variable. Although not shown here, the equations estimated were otherwise identical to those in Table 3.

importantly, the grade 7 results indicate that while the extended intervention to grade 2 is significantly associated with reading achievement and grade retention, an additional year is associated with even larger effects.

Effects of Two versus Three Years

Finally, Table 5 presents supplemental evidence of the effects of extending the follow-on program for one additional year for the subsample of students who all participated in the follow-on program for two or three years. This subsample consists of all students who participated in the maximum number of years of the program offered to them. The follow-on program is offered through grade 2 in fourteen CPC schools and through grade 6 in six CPC schools. Because the CPC schools are spread across different neighborhoods, the administration-induced variation in program offerings provides for a natural experiment within the larger quasi-experiment, given the likelihood that the decision to enroll in one or the other of these types of schools in preschool is relatively uncorrelated with student attributes that also would be correlated with student achievement. Hence the natural variation in program exposure across neighborhoods helps generate estimates of the third year of the follow-on program that are the most likely to be unbiased. Although not shown here, the mean values of the explanatory variables listed in Table 1 were equal for each variable across the two full-intervention groups. In addition to there being no significant differences in the kindergarten pretests of these two full-intervention groups, it should also be noted that these groups exhibited no statistically significant differences in the growth rates of achievement between kindergarten and the end of second grade.

Consistent with the findings from the larger sample, the results indicate that the effects of the third year of participation in the follow-on program are especially noticeable on the grade 3 tests that are taken immediately at the end of the third year of the follow-on program. The grade 7 results generally are consistent with those observed in specification II of Table 4. The marginal impact of the

TABLE 5
Maximum Likelihood Estimation of the Effects of the Third Year of Follow-on for the Reduced Sample

	Math 3	Reading 3	Math 7	Reading 7	Grade Retention
Follow-on through third grade	5.78 (0.04)*	6.88 (0.00)*	2.94 (0.18)	4.58 (0.052)*	-0.103 (0.02)*
Female	1.58 (0.21)	4.83 (0.00)*	2.20 (0.15)	4.59 (0.01)*	-0.121 (0.01)*
Family low income	-0.55 (0.77)	-1.39 (0.54)	-2.68 (0.24)	-3.65 (0.17)	0.059 (0.42)
Parent education	3.89 (0.03)*	5.45 (0.00)*	5.71 (0.00)*	5.58 (0.01)*	-0.041 (0.35)
Missing information	-0.49 (0.96)	1.78 (0.73)	-2.98 (0.40)	-3.31 (0.42)	0.022 (0.75)
School poverty rate	-0.50 (0.39)	-0.24 (0.78)	0.05 (.55)	0.05 (0.63)	-0.001 (0.51)
Mathematics achievement at end of kindergarten	0.33 (0.00)*	0.31 (0.00)*	0.43 (0.00)*	0.42 (0.00)*	-0.005 (0.00)*
Reading achievement at end of kindergarten	0.35 (0.00)*	0.49 (0.00)*	0.41 (0.00)*	0.46 (0.00)*	-0.003 (0.07)#
Achievement growth during kindergarten	-0.32 (0.00)*	-0.38 (0.00)*	-0.42 (0.00)*	-0.48 (0.00)*	0.005 (0.01)*
Constant	60.20 (0.00)*	54.40 (0.00)*	95.62 (0.00)*	91.90 (0.00)*	0.67 (0.00)*
Moves from grades 3–7	—	—	-1.91 (0.43)	-2.43 (0.28)	0.01 (0.84)
Correlation in errors between sample retention and outcome equations	-0.03 (0.99)	-0.23 (0.85)	0.13 (0.88)	0.15 (0.84)*	0.08 (0.91)

Notes: N=426. Significance levels for a two-tailed t-test are in parentheses. Follow-on through third grade is coded 1 for students who participated through third grade; 0 for students who participated in Follow-on in schools that offered the program through second grade only. Maximum likelihood estimates were obtained from the joint estimation of each outcome equation simultaneously with an equation for sample selection.

third year of the follow-on program as of grade 7 is positive and significant for reading achievement and grade retention but not math achievement. Relative to participation in extended intervention to grade 2, participation through grade 3 was associated with a 4.6-point gain in reading achievement and a 10.3 percent percentage-point decline in grade retention.

DISCUSSION

This study investigated the added effect of participation in an extended follow-on intervention from ages 3 to 8 on children's school achievement and academic progress four to five years after the end of the program. Using a restricted comparison-group strategy that took into account school mobility, kindergarten pretest achievement and growth, and sample attrition, the results indicate that participation in extended intervention was significantly associated with higher reading and math achievement in grade 7 and a lower rate of grade retention. Children who participated in three years of the follow-on program after preschool and kindergarten had the highest achievement test scores and the lowest rate of grade retention.

Findings support those in the two-year follow-up (Reynolds, 1994) and indicate that extended childhood programs can independently promote school achievement and reduce the likelihood of grade retention. By separating the effects of follow-on intervention from earlier intervention and by tracing the stability of effects into early adolescence, this study provides rare evidence for the effects of large-scale, extended early childhood programs. Consequently, the findings of this study are more likely to generalize to large-scale established programs for inner-city children than many previous studies. As indicated in the introduction, extended early childhood interventions are designed to provide educational and family support services during two sensitive periods of development—the preschool years and the transition to formal schooling. In the context of poverty and its harmful consequences,

such services may help enhance children's developmental continuity (Entwisle & Alexander, 1993; Entwisle & Hayduk, 1988).

Importantly, our findings indicate that follow-on intervention adds significantly to the effect of preschool and kindergarten intervention. They *do not* indicate that preschool and kindergarten intervention are ineffective or that follow-on intervention alone is better than earlier intervention. Previous analyses in the Chicago Longitudinal Study (Reynolds, 1995; Reynolds & Temple, 1995) attest to the positive and significant influence of preschool participation on child outcomes. The results show that enrollment through grades 2 or 3 in the follow-on program, given earlier enrollment in a Head Start-type program of compensatory education in preschool and kindergarten, generates positive effects on math and reading achievement that last through at least grade 7.

Also, children were not randomly assigned to treatment groups. Enrollment in the intervention groups was based on natural variation, which was statistically modeled through a restricted quasi-experimental analytic approach. As is the case with all quasi-experiments, it remains possible that unmeasured individual, family, or school-level factors may be responsible for part of the observed statistical relationship between program participation and academic outcomes. Although unmeasured factors may exist, several aspects of our analytic approach may compensate for the absence of random assignment. First, in order to create a comparison group that was most similar to the follow-on group, students who were highly mobile from kindergarten through third grade were excluded from the analysis. Moreover, estimates of the effects of extended intervention were obtained after controlling for postprogram school mobility. Because the CPC Program was designed, in part, to promote a stable school learning environment for children and their families, removing group differences in school mobility during and after the program probably biases downward the estimates of program effectiveness. A second compensatory strategy of the analysis was that three measures of kindergarten achievement were utilized to estimate effects: reading and math achievement, and growth in

achievement. We are aware of no other studies of early intervention that have included such an array of control variables. In addition, our estimation procedure corrects for biases due to nonrandom sample selection through attrition.

Thus, findings provide conservative estimates of the added effect of participation in extended early childhood intervention. Indeed, it could be argued that we overcontrolled for differences between groups by removing the effects of school mobility and by including three measures of cognitive pretest differences. Given the possibility of selection bias due to natural variation as well as the skepticism by which quasi-experimental findings are often met, we believe this approach was scientifically appropriate. It also provides a foundation from which to compare other analytic approaches to program evaluation.

Although the findings of this study support some previous analyses of extended interventions (Fuerst & Fuerst, 1993; Seitz, Apfel, Rosenbaum, and Zigler, 1983), they differ in some respects with the follow-up results from the Abecedarian Program. Both the Abecedarian Program (Campbell & Ramey, 1995) and a previous CPC study (Reynolds, 1994) found positive associations between duration of intervention and school performance; both programs found no significant longer-term effects of school-age intervention alone. The Abecedarian Program, however, found independent effects of extended intervention for reading achievement only. The current study (along with the 1994 study) finds positive effects for reading and mathematics achievement and grade retention.

Several explanations can be offered for the different findings between the Abecedarian Program and the Chicago CPCs. In the Abecedarian Program, the school-age program includes a home/school resource teacher who visits families in their home and helps mobilize resources. The CPC Program includes a similar teacher for school-based activities (the curriculum parent-resource teacher) but also provides reduced class sizes and teacher aides for participating students, which allows for greater emphasis on basic skills. Second, the two programs are implemented at different ages. The

Abecedarian Program provides school-age services from kindergarten to second grade; in the CPC Program services are from first grade to third grade. Timing of program services could matter, especially since in the present study, the three-year follow-on group through third grade had better school performance than the two-year group through second grade. Finally, the socioeconomic contexts of the programs were different. The Abecedarian Program was implemented in schools serving mostly middle-income white children while the CPCs are located in inner-city communities serving mostly poor black children. Extended programs in high-poverty schools may have a greater impact than programs in more socioeconomically advantaged contexts. Regardless of the consequences of these differences, further research is warranted to examine the characteristics of different school-age programs, their duration, and long-term effects.

Another issue in investigating the effects of early childhood programs is the fundamental difference in the interpretation of the effects of preschool programs versus programs for school-aged children. In the evaluation of preschool programs, treated children often are compared to children with no center-based intervention of any kind. This represents an absolute comparison approach contrasting the effects of a program versus no program. In school-age interventions, the comparison is relative rather than absolute: the target treatment versus another treatment, which is regular school instruction. For school-aged programs, significant differences between program participants and nonparticipants are observed only to the extent that the programs add value above and beyond regular instruction.

Finally, we suggest that the reason that extended early childhood programs may be more effective than programs of shorter duration is not just due to the fact that a larger “dose” of compensatory education is more effective than a smaller dose. Extended intervention programs encourage stability in school and home learning environments and they occur at a very important time in children’s development—the transition to formal schooling. In a time of increased interest in

compensatory education programs that begin in infancy, findings that extra investments in programs for school-aged children can also be effective should not be overlooked.

Notes

[1]We stress that the results in this paper are obtained from a large-scale, long-established, publicly funded, nonmodel program. This is important because, as Sawhill (1992) explains, previous findings of long-lasting effects of compensatory education programs typically were obtained from small-scale studies. As more and more children are served, the existing evidence suggests that positive effects are less likely to be observed (Sawhill, 1992, pp. 165–171).

[2]The students in the sample were enrolled in CPCs beginning in preschool. These CPCs are associated with individual schools, so that the children do not have to change schools as they progress through the primary grades. Interestingly, the Chicago Public School System is based on a system of K–8 schools, with high schools comprising grades 9–12. Hence the most school-stable students in the sample do not change schools until after grade 8.

[3]Of the original 1,539 students followed by the Chicago Longitudinal Study of Children at Risk, approximately 5 percent were excluded because they were Hispanic and were not sampled in sufficiently large numbers. The remaining students are all African Americans. Requiring that all the sample children were participants in the CPC Program in preschool and kindergarten reduced the sample to 765. In order to enhance group comparability, 81 comparison-group children were excluded because they changed school more than once between kindergarten and third grade. In addition, 58 children were excluded who participated in only one year of follow-on intervention. However, they were taken into account in the analysis of sample attrition (see Table 3). The final sample of 559 includes only those students who had test scores in both grades 3 and 7.

[4]A good exposition of the importance in evaluating educational programs of controlling for sample selection due to data loss is found in Becker and Walstad (1990). That study, however, uses a two-stage estimation procedure involving Heckman's lambda that produces consistent but inefficient estimates. The maximum likelihood approach used in the current study generates estimates that are

consistent and efficient. For further description of the Heckman sample selection method, see Heckman (1979) and Greene (1993).

[5]The numbers in parentheses in the notes to Table 2 are the grade equivalents associated with each standardized score. For example, the national average for reading comprehension in grade 3 is 3.8, meaning that the average students tests at the level of the eighth month of the third year in school. (The tests are taken in April, which is the eighth month of the school year.) In Chicago, however, the typical student scores almost a complete year behind (scoring at the level of the ninth month of the second year).

References

Abelson, W. D., Zigler, E. F., & DeBlasi, C. L. 1974. "Effects of a Four-Year Follow Through Program on Economically Disadvantaged Children." *Journal of Educational Psychology* 66, 756–771.

Alexander, K. L., & Entwisle, D. R. 1988. "Achievement in the First 2 Years of School: Patterns and Processes." *Monographs of the Society for Research in Child Development* 53 (2, Serial No. 218).

Barnett, W. S. 1992. "Benefits of Compensatory Preschool Education." *Journal of Human Resources* 27: 279–312.

Barnow, B. S., & Cain, G. G. 1977. "A Reanalysis of the Effect of Head Start on Cognitive Development: Methodology and Empirical Findings." *Journal of Human Resources* 12: 177–197.

Becker, W. E., & W. B. Walstad. 1990. "Data Loss from Pretest to Posttest as a Sample Selection Problem." *Review of Economics and Statistics* 72: 184–188.

Berk, R. A. 1988. "Causal Inference for Sociological Data." In N. J. Smelser (Ed.), *The Handbook of Sociology*. Newbury Park, Calif.: Sage.

Breusch, T. & Pagan, A. 1980. "The LM Test and its Application to Model Specification in Econometrics." *Review of Economic Studies* 47: 239–254.

Campbell, F. A., & Ramey, C. T. 1994. "Effects of Early Intervention on Intellectual and Academic Achievement: A Follow-up Study of Children from Low-income Families." *Child Development* 65: 684–698.

Campbell, F. A., & Ramey, C. T. 1995. "Cognitive and School Outcomes for High Risk African-American Students at Middle Adolescence: Positive Effects of Early Intervention." *American Educational Research Journal* 32: 743–772.

Chicago Public Schools. 1985. *Meeting the Mandate: Chicago's Government-funded Kindergarten Programs.* Chicago: Department of Research and Evaluation.

Chicago Public Schools. 1987. *Chapter 2 All-Day Kindergarten Program Final Evaluation Report: Fiscal 1986.* Chicago: Department of Research and Evaluation.

Consortium for Longitudinal Studies. 1983. *As the Twig is Bent*. Hillsdale, NJ: Erlbaum.

Cole, M., & Cole, S. R. 1993. *The Development of Children.* New York: Scientific American Books.

Conrad, K. J., & Eash, M. J. 1983. "Measuring Implementation and Multiple Outcomes in a Child Parent Center Compensatory Education Program." *American Educational Research Journal* 20: 221–236.

Cook, T. D., & Campbell, D. T. 1979. *Quasi-Experimentation: Design and Analysis for Field Settings.* Chicago: Rand McNally.

Cook, T. D., & Shadish, W. R. 1994. "Social Experiments: Some Developments over the Past Fifteen Years." *Annual Review of Psychology* 45: 545–580.

Currie, J. & Thomas, D. 1995. "Does Head Start Make a Difference?" *American Economic Review* 85 (June): 341–364.

Entwisle, D. R., & Alexander, K. L. 1993. "Entry into School: The Beginning School Transition and Educational Stratification in the United States." *Annual Review of Sociology* 19: 401–423.

Entwisle, D. R., & Hayduk, L. A. 1988. "Lasting Effects of Elementary School." *Sociology of Education* 61: 147–159.

Fuerst, J. S., & Fuerst, D. 1993. "Chicago Experience with an Early Childhood Program: the Special Case of the Child Parent Center Program." *Urban Education* 28: 69–96.

Garmezy, N., & Rutter, M., eds. 1988. *Stress, Coping and Development in Children.* Baltimore: Johns Hopkins Press.

General Accounting Office. 1994. "lementary School Children: Many Change Schools Frequently, Harming Their Education." Report GAO/HEHS-94-95, U.S. General Accounting Office, Washington, D.C.

Greene, W. 1993. *Econometric Analysis* (2nd ed.). New York: Macmillan.

Haskins, R. 1989. "Beyond Metaphor: The Efficacy of Early Childhood Education." *American Psychologist* 44: 274–282.

Heckman, J. J. 1979. "Sample Selection Bias as a Specification Error." *Econometrica* 47: 153–161.

Hernandez, D. 1994. *Changing Demographics: Implications for Child Care, Policy, Programs, and Research.* Paper presented at the Seventh annual Rutgers Symposium on Early Childhood Education and Care. New Brunswick, NJ. October.

Hieronymus, A. N., & Hoover, H. D. 1990. *Iowa Tests of Basic Skills: Manual for School Administrators* (Supplement). Chicago: Riverside.

Jordon, T. J., Grallo, R., Deutsch, M., & Deutsch, C. P. 1985. "Long-Term Effects of Early Enrichment: A 20-Year Perspective on Persistence and Change." American Journal of Community *Psychology* 13: 393–415.

McKey, R. H., Condelli, L., Ganson, H., Barrett, B. J., McConkey, C., & Plantz, M. C. 1985. *The Impact of Head Start on Children, Families, and Communities* (DHHS Publication No. OHDS 85-31193). Washington, D.C.: U.S. Government Printing Office.

Moffitt, R. 1991. "Program Evaluation with Nonexperimental Data." *Evaluation Review* 15: 291–314.

National Head Start Association. 1990. *Head Start: The Nation's Pride, a Nation's Challenge.* Alexandria, VA: Author.

Reynolds, A. J. 1991. "Early Schooling of Children at Risk." *American Educational Research Journal* 28: 392–422.

Reynolds, A. J. 1992. "Mediated Effects of Preschool Intervention." *Early Education and Development* 3: 139–164.

Reynolds, A. J. 1994. "Effects of a Preschool Plus Follow-on Intervention for Children at Risk. *Developmental Psychology* 30: 787–804.

Reynolds, A. J. 1995. "One Year of Preschool Intervention or Two: Does it Matter?" *Early Childhood Research Quarterly* 10: 1–31.

Reynolds, A. J., & Bezruczko, N. 1993. "School Adjustment of Children at Risk Through Fourth Grade." *Merrill-Palmer Quarterly* 39: 457–480.

Reynolds, A. J., Mavrogenes, N. A., Bezruczko, N., & Hagemann, M. Forthcoming 1996. "Cognitive and Family-Support Mediators of Preschool Effectiveness: A Confirmatory Analysis." *Child Development* 67.

Reynolds, A. J., Mehana, M., & Temple, J. A. 1995. "Does Preschool Intervention Affect Children's Perceived Competence?" *Journal of Applied Developmental Psychology* 16: 211–230.

Reynolds, A. J., & Temple, J. A. 1994. *Effects of Extended Childhood Intervention from the Longitudinal Study of Children at Risk.* Paper presented at the annual meeting of the Association of Public Policy Analysis and Management, Chicago. October.

Reynolds, A. J., & Temple, J. A. 1995. "Quasi-Experimental Estimates of the Effects of a Preschool Intervention: Psychometric and Econometric Comparisons." *Evaluation Review* 19: 347–373.

Rossi, P. H., & Freeman, H. E. 1993. *Evaluation: A Systematic Approach* (5th ed.). Newbury Park, Calif.: Sage.

Sawhill, I. V. 1992. "Young Children and Families." In H. J. Aaron and C. L. Schultze (eds.), *Setting Domestic Priorities: What Can Government Do?* Washington, D.C.: The Brookings Institution.

Seitz, V., Apfel, N., Rosenbaum, L., & Zigler, E. 1983. "Long-Term Effects of Projects Head Start and Follow Through: The New Haven Project." In Consortium for Longitudinal Studies (eds.), *As the Twig is Bent: Lasting Effects of Preschool Programs*, pp. 299–332. Hillsdale, N.J.: Erlbaum.

Winship, C., & Mare, R. D. 1992. "Models of Sample Selection Bias." *Annual Review of Sociology* 18: 327–350.

Wood, D., Halfon, N., & Scarlata, D. 1993. “Impact of Family Relocation on Children’s Growth, Development, School Function, and Behavior.” *Journal of the American Medical Association* 270 (September 15): 1334–38.

Zigler, E., & Styfco, S., eds. 1993. *Head Start and Beyond: A National Plan for Extended Childhood Intervention*. New Haven: Yale University Press.