Institute for Research on Poverty
Discussion Paper no. 1180-98

Can Early Intervention Prevent High School Dropout? Evidence from the Chicago Child-Parent Centers

Judy A. Temple
Department of Economics
Northern Illinois University
E-mail: jtemple@niu.edu

Arthur J. Reynolds
School of Social Work
University of Wisconsin–Madison

Wendy T. Miedel
Department of Child and Family Studies
University of Wisconsin–Madison

November 1998

This research was supported by a National Academy of Education Spencer Postdoctoral Fellowship to the first author and by a grant from the U.S. Department of Education's National Institute for the Education of At-Risk Students to the second author. A previous version of this paper was presented at the 4th Head Start Research Conference in July 1998 in Washington, DC.

IRP publications (discussion papers, special reports, and the newsletter *Focus*) are now available on the Internet. The IRP Web site can be accessed at the following address: http://www.ssc.wisc.edu/irp/

Abstract

We investigate the effects of participation in the Chicago Child-Parent Center and Expansion Program from ages 3 to 9 on early school dropout at age 17. The Child-Parent Centers offer a government-funded educational intervention program in preschool through second or third grade in 20 locations in Chicago's poorest neighborhoods. Using data from the Chicago Longitudinal Study, we address two major questions: (1) Is participation in the Child-Parent Centers program associated with a lower rate of high school dropout at age 17? (2) Which nonintervention variables predict high school dropout? After comparing children in 20 intervention sites with similar children who attended schools in similarly poor neighborhoods in which the intervention program was not offered, we find that participation in the intervention offered by the Child-Parent Centers is associated with a 7 or 8 percentage point reduction in the probability of dropout. Our findings also indicate that parental involvement in schooling and avoidance of frequent school mobility are important predictors of high school completion.

Can Early Intervention Prevent High School Dropout? Evidence from the Chicago Child-Parent Centers

INTRODUCTION

Although there is strong evidence that good-quality early childhood interventions have meaningful effects on academic and social development in both the short and longer term (Karoly et al., 1998), only a handful of studies investigate the link between early intervention and high school completion or dropout. Only three of the 21 large-scale public programs reviewed by Barnett (1995) presented any evidence from high school or beyond, and only one (Fuerst and Fuerst, 1993) found significant intervention effects on school dropout. Of the 15 small-scale model or demonstration programs reviewed by Barnett (1995), again only three specifically examined high school dropout. Each of those studies showed reductions in the probability of high school dropout for intervention participants versus nonparticipants. Of the three studies, the most notable effects were observed in the High/Scope Perry Preschool Program (Schweinhart and Weikart, 1988; Schweinhart et al., 1993).

The relative lack of long-term evidence for high school graduation is surprising because high school completion is perhaps the quintessential indicator to assess the long-term effects of early childhood intervention. Given that graduation from high school is a major predictor of socioeconomic status and earnings in adulthood, high school completion is a watershed indicator of the success of education intervention. Additional investigations of whether early childhood intervention prevents high school dropout will add significantly to the knowledge base.

In this paper, we use a sample of over 1,100 urban youth to examine the relationship between high school dropout and participation in an early childhood educational intervention called the Chicago Child-Parent Center and Expansion Program. Our work on the Child-Parent Centers adds to the previously published findings of Fuerst and Fuerst (1993), who analyzed the effects of the Chicago-based intervention using a group of students who participated in it during various years during the period

1965–77. Our data come from the Chicago Longitudinal Study (Reynolds, 1994), a prospective study that follows the 1985–86 kindergarten cohort of the Chicago Child-Parent Centers. Previous analyses using the Chicago Longitudinal Study have consistently demonstrated positive effects of participation in the Child-Parent Center and Expansion Program on school achievement and avoidance of grade retention and special education placement up to age 13 or 14 for preschool participation, for extended participation up to second or third grade, and for duration of participation (Reynolds and Temple, 1998).

Because both early school achievement and grade retention commonly are found to be important predictors of high school dropout (Alexander, Entwisle, and Horsey, 1997; Roderick, 1994), we hypothesize that participation in the Child-Parent Center (CPC) program will be significantly associated with a lower rate of school dropout. In addition to our focus on estimating the effect of early intervention on the probability of dropping out of high school, we also investigate the contributions of grade retention, school mobility, and early school achievement to dropout. Although the connection between high school completion and family characteristics such as parent educational attainment and family income has been well documented in other studies (e.g., Haveman, Wilson, and Wolfe, 1998; Haveman and Wolfe, 1994), we also include a teacher-reported measure of parental involvement in schooling as a potential predictor of high school dropout.

A recent study by President Clinton's National Science and Technology Council argued that the dropout rate in the U.S. is unacceptably high, with annual costs of over $250 billion in terms of lost earnings and forgone tax revenues (National Science and Technology Council, 1997). Analysis of the factors associated with high school dropout in an inner-city sample is especially important because urban children from low-income families are at the greatest risk of school failure (U.S. Department of Education, 1997). Previous large-sample studies of urban black children, by Ensminger and Slusarcick (1992) for example, have shown that school dropout can be predicted by school achievement and family income observed in the early school years. As in the current study, Ensminger and Slusarcick analyzed

longitudinal data drawn from a large cohort of black children from a poor Chicago neighborhood. Those authors, however, did not investigate the role of early educational intervention as a predictor of high school completion.

THE INTERVENTION

The CPC program is a center-based early intervention that provides comprehensive educational and family-support services to economically disadvantaged children from preschool to early elementary school. The CPC program was established in Chicago in 1967 through funding from Title 1 of the Elementary and Secondary Education Act of 1965. The CPC program offers services to students and their families in 25 sites in high-poverty neighborhoods in Chicago. Child-Parent Centers typically are located next to or across the street from public elementary schools in small buildings built specifically for the program. Some of the CPC sites are located in the wings of the elementary school buildings themselves.

The overall goal of the program is to promote children's academic success and to facilitate parent involvement in children's education. Students and their parents can participate during preschool through second or third grade for up to 5 or 6 years of extended intervention. Main features of the program include low child-to-teacher ratios in preschool (17 to 2) and kindergarten (25 to 2), a structured set of language-based instructional activities that focus on reading readiness, and a multifaceted parent program conducted under the supervision of the Parent-Resource Teacher. A comprehensive school-aged program from first to second or third grade supports children's transition to elementary school. More information about the Chicago Child-Parent Center program can be found in Reynolds, Miedel, and Mann (1998).

DATA

Data are drawn from the Chicago Longitudinal Study (CLS), a prospective study that traces the school performance of approximately 1,500 minority students from high-poverty neighborhoods who entered public kindergartens in 1985. Ninety-five percent of the sample is African American and 5 percent is Hispanic. The CLS employs a quasi-experimental study design to trace a cohort of students who graduated in 1986 from publicly funded kindergartens in 26 sites in Chicago's poorest neighborhoods.

The sample includes entire classrooms of students in 20 Child-Parent Centers. Entire classrooms of students in six non-CPC all-day kindergartens located in six equally poor neighborhoods were also included as a comparison group. The comparability of these two groups warrants additional explanation. The non-CPC comparison group children were eligible for the CPC intervention but were unable to participate because the CPC intervention was not offered in their neighborhoods. However, the non-CPC comparison group received a minimal intervention offered in their neighborhoods to students most in need of additional school services. The comparison group students participated in a full-day kindergarten program offered by the city of Chicago to students at risk of school failure due to family poverty. Both the treatment group and the comparison group were recruited into their respective programs based on most-in-need criteria. Some econometric and psychometric evidence supporting the comparability of these two groups is provided in Reynolds and Temple (1995).

If still in school, the continuously promoted students would be expected to graduate in spring 1998. We use a measure of early school dropout obtained primarily from the centralized records of the Chicago Public Schools. The dropout measure indicates whether or not a student has dropped out of school as of January 1998. In some cases, we were able to obtain additional information on the school progress of students who were no longer enrolled in the Chicago Public Schools. The main results presented in this report are based on the 1,159 students for whom dropout information is available.

Of the 1,159 students for whom dropout or school continuation information is known, 873 participated in the CPC program in one of 20 sites located in high-poverty neighborhoods. Although 762 of these students began their participation in the program in preschool, ultimately only 329 participated in the full intervention for as long as 5 or 6 years. Of the 873 students who participated in the intervention, 111 of them began their participation after preschool. The current sample of 1,159 also includes 276 students who did not participate in the Child-Parent Centers because they lived in different neighborhoods not served by the CPC program. Those students, however, also had a kindergarten intervention in the form of an all-day kindergarten program offered by some Chicago Public Schools located in poor neighborhoods.

SAMPLE CHARACTERISTICS FOR THE CURRENT STUDY

Information on school progress is available for 1,159 students of the original 1,539 students in the CLS, reflecting a sample retention rate of 75 percent. As shown in Table 1, the current sample of 1,159 consists of 818 students known to still be in school or to have graduated. Most of the students are currently attending the Chicago Public Schools. Some students have been successfully located after leaving the Chicago Public Schools, and some of these students were found to still be attending private schools in Chicago or public or private schools outside Chicago.

Table 1 indicates that 341 students are not currently enrolled in high school diploma- or GED-granting educational institutions. Over 300 students are known dropouts from the Chicago Public Schools, and five students are known to have dropped out of other schools. Also considered to be dropouts are some students who are enrolled in residential or correctional facilities and students who are attending alternative high school programs. However, because 57 students enrolled in residential or correctional facilities or alternative high schools are currently enrolled in GED-granting programs, we include them as continuing students or non-dropouts in the analyses.

TABLE 1

Students with Dropout Status Determined as of January 1998 (N = 1159)

Students still in school or graduated	
Attending Chicago Public Schools	725
Attending private school in Chicago	13
Attending school outside Chicago	18
Graduated	5
Subtotal	**761**
Attending GED-granting residential/correctional facility or alternative program	57
Total	**818**
Students considered to be dropouts	
Dropped out of Chicago Public Schools	314
Dropped out of private school in Chicago	1
Dropped out of school outside Chicago	4
Attending non GED-granting residential/correctional facility or alternative program	22
Total	**341**

Approximately 29 percent of the 1,159 students had dropped out of school as of January 1998. Table 2 shows dropout rates by gender and by intervention groups. Boys have almost a 35 percent dropout rate, while the rate for girls is just under 25 percent. Students who participated in the CPC intervention during preschool have a dropout rate of 26.8 percent; students who participated in the CPC intervention for a total of 5 or 6 years have a dropout rate of 22.8 percent; students who had no involvement in the CPC program have a dropout rate of 32.6 percent.

Participation in the CPC program for the full number of years (5 or 6) is associated with a lower incidence of dropout for both boys and girls. The dropout rate for girls who participated in the extended intervention is 5.2 percentage points lower than the overall dropout rate of 24.6 percent for girls, and the dropout rate for boys who participated in the extended intervention is 7.5 percentage points below the overall rate of 34.6 percent for boys. Differential gender dropout rates by other indicators of program participation exist for all levels of intervention experience. Boys who did not participate in the preschool component of the CPC program had a 40.7 percent dropout rate by January of what would have been their twelfth-grade year.

Because over 30 percent of the students in the sample were retained in grade at least once due to poor academic performance, Table 2 also shows how the dropout rate varies according to whether or not students were retained. For retained students, the dropout rate is 42.1 percent, which is much higher than the overall dropout rate of 29.4 percent. Students who were never retained have an overall dropout rate of 23.6 percent. The grade-retention/dropout connection holds for both girls and boys. Boys who were retained in grade had a 43.7 percent dropout rate as of January 1998.

Table 3 shows the mean statistics for the original sample of 1,539 and the current sample of 1,159 students whose dropout status is known. The original sample was evenly split between boys and girls. Eighty-four percent of the students came from families that were eligible for free school lunch because of low family income. Almost two-thirds of the original sample participated in the CPC

TABLE 2

Dropout Rates as of January 1998

Overall dropout rate	29.4%
By gender[a]	
Girls	24.6
Boys	34.6
By intervention groups[b]	
Participation in CPC preschool	26.8
No participation in CPC preschool	34.5
Any CPC participation (preschool or follow-on)	28.4
No CPC participation	32.6
CPC participation for 5 or 6 years	22.8
By intervention groups and gender[c]	
Participation in CPC preschool	
Girls	23.2
Boys	31.0
No participation in CPC preschool	
Girls	27.7
Boys	40.7
Any CPC participation (preschool or follow-on)	
Girls	23.8
Boys	33.4
No CPC participation	
Girls	27.1
Boys	38.2
CPC participation for 5 or 6 years	
Girls	19.4
Boys	27.1
By grade retention experience and gender[d]	
Ever retained as of grade 8	42.1
Girls	39.7
Boys	43.7
Never retained as of grade 8	23.6
Girls	20.0
Boys	28.6

[a]Gender differences are significant at the 1% level for a two-tailed test.
[b]Mean difference for "Participation in CPC preschool" versus "No participation in CPC preschool" is significant at the 1% level. Mean difference for "CPC participation for 5 or 6 years" versus "No CPC participation" also is significant at the 1% level.
[c]All gender differences across intervention groups are significant at the 10% level or better.
[d]Gender differences for the never-retained students are significant at the 1% level.

TABLE 3

Descriptive Statistics for Entire Sample and by Known Dropout Status

Variable Name	Overall Mean (N=1539)	Mean for Known Status (n=1159)	Mean for Unknown Status (n=380)
Female	0.50	0.52	0.45*
Family low-income[a]	0.84	0.84	0.84
Parent HS graduate[a]	0.58	0.57	0.60
Missing information on family low-income or parent HS graduate	0.38	0.33	0.56***
End of K word score	63.8	63.8	63.7
Participated in CPC preschool for 1 or 2 years	0.64	0.66	0.60*
CPC participation for 1 or 2 years	0.15	0.14	0.21***
CPC participation for 3 or 4 years	0.34	0.34	0.33
CPC participation for 5 or 6 years	0.26	0.28	0.18***
# of school moves grades 4–7	1.42	1.09	2.45***
Ever retained (K–8)	0.34	0.31	0.41***
Ever placed in special ed (K–8)	0.16	0.18	0.11***
Years of high parental involvement	1.51	1.71	0.93***

[a]Means reported before imputation for missing data.
* $p < .05$; ** $p < .01$; *** $p < .001$

preschool program, and 36 percent of the sample participated in both the preschool component and the primary grade component of the intervention through second or third grade.

The current sample of 1,159 differs from the original sample in a number of characteristics. Table 3 indicates how the sample of 1,159 differs from the 380 students whose current school progress is unknown. Although the students with information on current school progress are more likely to be girls, there is no statistically significant difference in family income or parent education. However, the students whose current school progress is not known are much more likely to have missing data on the family income and parent education variables.

There is no statistically significant difference in the kindergarten achievement measure (a score for word recognition from the Iowa Tests of Basic Skills) for both subsamples. Students whose school progress is known were more likely to have participated in the preschool portion of the intervention program and were more likely to have participated in the intervention for a total of 5 or 6 years. Students with known school progress are less likely to have changed schools or to have been retained in grade or ever placed in special education. Elementary school teachers of the students whose school progress is known are more likely to have reported high levels of parental involvement.

Table 4 compares the characteristics of the 818 students who are currently enrolled (or have graduated) and the 341 students who are considered to be dropouts. The continuing students are more likely to be girls and are less likely to come from low-income families or families in which the parents have less than a high school education. The kindergarten test scores of the dropouts differ significantly from the continuing students. Continuing students are more likely to have participated in the extended intervention during preschool and the primary grades. The continuing students are less likely to have experienced frequent school mobility and are less likely to have been retained or have been placed in special education. Teachers were more likely to have reported higher levels of parental involvement in elementary school for the students who are still continuing.

TABLE 4

Descriptive Statistics for Students with Known Dropout Status

Variable Name	Mean for Known Status (n=1159)	Mean for Dropouts (n=341)	Mean for Continuing Students (n=818)
Female	0.52	0.43	0.55***
Family low-income[a]	0.84	0.89	0.83*
Parent HS graduate[a]	0.57	0.49	0.60**
Missing information on family low-income or parent HS graduate	0.33	0.40	0.30***
End of K word score	63.8	61.5	64.7***
Participated in CPC preschool for 1 or 2 years	0.64	0.66	0.60*
CPC participation for 1 or 2 years	0.15	0.14	0.21***
CPC participation for 3 or 4 years	0.34	0.34	0.33
CPC participation for 5 or 6 years	0.26	0.28	0.18***
Ever retained (K–8)	0.31	0.45	0.26***
Ever placed in special ed (K–8)	0.18	0.23	0.16**
Years of high parental involvement	1.71	1.34	1.86***

[a]Means reported before imputation for missing data.
* $p < .05$; ** $p < .01$; *** $p < .001$

Table 5 shows how socioeconomic and post-intervention characteristics of students vary across several different intervention groups. In columns A and B, the means for students who participated in the preschool program versus those students who did not enroll in the preschool program are contrasted. A total of 762 students participated in the preschool portion of the CPC program, while 397 students did not attend the preschool portion. Girls are more likely to have attended the preschool portion of the intervention. Students in these two intervention groups are similar in family income and parent education. Additional evidence on the comparability of the CPC preschool treatment group versus the no-preschool comparison group in terms of measured and unmeasured student characteristics can be found in Reynolds and Temple (1995). As shown in previous studies with these data (Reynolds and Temple, 1998; Reynolds and Temple, 1995), students who participated in the preschool program have higher test scores in kindergarten and have a lower rate of school mobility, grade retention, and special education placement.

In an attempt to examine the importance of the duration of the intervention program, this study also reports estimates by length of intervention experience. Columns C and D report the mean characteristics of the 329 students with 5 or 6 years of intervention experience and the 276 students who did not participate at all in the intervention. (Note that some of the students in column B had CPC participation beginning after preschool.) The mean comparisons of the full-intervention group with the no-intervention group show no evidence of any mean differences in gender or family income. Although a comparison of columns A and B shows that students who originally enrolled in the CPC preschool were similar to the comparison group in terms of parent education, columns C and D show that students with a parent who is a high school graduate are more likely to have participated in the CPC program during preschool and into second or third grade. As shown in earlier studies with these data (e.g., Reynolds, 1994), students with the extended intervention experience demonstrate higher kindergarten test scores and lower rates of mobility, grade retention, and special education placement. For both measures of

TABLE 5

Mean Characteristics of Students with Known Dropout Status by Intervention Group

Variable Name	(A) Participation in CPC Preschool for 1 or 2 Years (N=762)	(B) No Participation in CPC Preschool (N=397)	(C) Extended CPC Intervention for 5–6 years (N=329)	(D) No CPC Intervention (N=276)
Female	0.54*	0.47	0.56	0.51
Family low-income[a]	0.84	0.85	0.82	0.85
Parent HS graduate[a]	0.58	0.56	0.63*	0.53
Missing information on family low-income or parent HS graduate	0.31#	0.36	0.27*	0.37
End of K word score	66.0*	59.5	69.0*	59.0
# of school moves grades 4–7	0.95*	1.35	0.71*	1.39
Ever retained during K–8	0.26*	0.41	0.19*	0.42
Ever placed in special education K–8	0.15*	0.24	0.11*	0.22
Years of high parental involvement	1.82*	1.49	2.20*	1.55

The mean difference comparisons are for column A versus B, and then column C versus D.
[a]Means reported before imputation for missing data.
* denotes significance at the 5% level; # denotes 10%.

intervention (any preschool or extended intervention for 5 or 6 years), there is strong evidence from teacher ratings that the intervention group parents have higher levels of school involvement.

REGRESSION ESTIMATES

Tables 6 and 7 report estimates of the predictors of high school dropout using probit models of increasing complexity. The dependent variable is high school dropout, where high school dropout is coded as 1 and continuing students are coded as 0. Although probit estimation generates estimated coefficients that are not directly interpretable, the coefficients in Table 6 have been transformed by taking the partial derivative of the continuous mean function. These estimates were easily obtained from canned procedures in the LIMDEP software program (Greene, 1995). The coefficients in Table 6 reflect the effect of a change in the value of the explanatory variable on the predicted probability of high school dropout. For example, the estimated coefficient for gender in Model 1 indicates that holding other factors constant, girls have a 10 percent lower probability of high school dropout. (Though not shown here, alternative methods of transforming the probit coefficients generate very similar results.)

Model 1 shows the main estimation equation of interest. In this column, early predictors of high school dropout are included in the regression equation. The findings indicate that student gender, family income, and parent education measured early in school all predict high school dropout. The statistical significance of the intervention variable offers evidence of a strong association between enrollment in the CPC preschool program and a higher subsequent probability of remaining in high school. The estimated coefficient on the intervention variable indicates that students who enrolled in the CPC program in preschool have a 7 percent lower probability of high school dropout.

Models 2 and 3 demonstrate the importance of subsequent school events in predicting high school dropout. In Model 2, three variables representing school mobility, grade retention experience, and special education placement are included in the estimation equation. Both school mobility and grade

TABLE 6

Participation in the Child-Parent Center Preschool Program and Other Predictors of High School Dropout as of January 1998
(Probit Estimates)

Variable Name	Model 1	Model 2	Model 3
Constant	-0.17*	-0.30*	-0.23*
Female	-0.10 (3.58)*	-0.07 (2.47)*	-0.07 (2.41)*
Family low-income	0.11 (2.32)*	0.10 (2.08)*	0.10 (2.02)*
Parent HS graduate	-0.09 (2.69)*	-0.08 (2.27)*	-0.07 (2.16)*
Missing information on family low-income or parent HS graduate	0.02 (0.72)	0.00 (0.29)	-0.02 (0.62)
Participated in the CPC preschool for 1 or 2 years	-0.07 (2.33)*	-0.03 (0.99)	-0.03 (0.94)
# of school moves during grades 4–7	—	0.05 (4.21)*	0.04 (3.49)*
Ever retained during K–8	—	0.12 (4.04)*	0.11 (3.50)*
Ever placed in special education K–8	—	0.04 (0.98)	0.03 (0.87)
Years of high parental involvement	—	—	-0.03 (2.40)*

N=1159; *t*-statistics in parentheses.
Probit coefficients have been transformed to represent marginal effects using the partial derivative of the conditional mean function.
* denotes statistical significance at the 5% level for a two-tailed test; # denotes 10% level.

TABLE 7

Years of Participation in the Child-Parent Center and Expansion Program and Other Predictors of High School Dropout as of January 1998
(Probit Estimates)

Variable Name	Model 1	Model 2	Model 3
Constant	-0.19*	-0.32*	-0.26*
Female	-0.10 (3.59)*	-0.07 (2.45)*	-0.07 (2.40)*
Family low-income	0.11 (2.29)*	0.10 (2.05)*	0.10 (2.00)*
Parent HS graduate	-0.09 (2.69)*	-0.08 (2.27)*	-0.07 (2.10)*
Missing information on family low-income or parent HS graduate	0.03 (0.76)	0.00 (0.10)	-0.02 (0.54)
CPC participation for 1 or 2 years	-0.02 (0.43)	-0.01 (0.19)	-0.02 (0.34)
CPC participation for 3 or 4 years	-0.02 (0.55)	0.02 (0.69)	0.02 (0.57)
CPC participation for 5 or 6 years	-0.08 (2.17)*	-0.02 (0.52)	-0.01 (0.36)
# of school moves during grades 4–7	—	0.05 (4.16)*	0.04 (3.50)*
Ever retained during K–8	—	0.12 (4.08)*	0.11 (3.59)*
Ever placed in special education K–8	—	0.37 (1.04)	0.34 (0.96)
Years of high parental involvement	—	—	-0.03 (2.30)

N=1159; *t*-statistics in parentheses.
Probit coefficients have been transformed to represent marginal effects using the partial derivative of the conditional mean function.
* denotes statistical significance at the 5% level for a two-tailed test; # denotes 10% level.

retention are predictors of high school dropout. The statistical significance of the intervention measure becomes diminished as these school events are included in the analysis. That is not surprising, however, because these school events can themselves be considered to be outcomes of the early intervention.

In the final column, a measure of parental involvement is added to the analysis. Although many studies have linked participation in early intervention to greater school attainment, many researchers have argued that families must be included in the intervention program in order for the students to sustain the cognitive benefits of early intervention (Benasich, Brooks-Gunn, Clewell, 1992; Bronfenbrenner, 1974). Because an important goal of the Child-Parent Centers is to increase parental involvement in schools, we investigate whether parental involvement is negatively related to the probability of dropout. The measure of parental involvement is the number of years during grades 1 through 6 that the student's teacher rated parental involvement in school as average or better. The estimated coefficient indicates that each year of high parental involvement (as indicated by teacher ratings) is associated with a lower probability of high school dropout by 3 percentage points.

Table 7 is similar to Table 6 except that the intervention is now described by length of intervention experience. Three dummy variables represent different durations of intervention enrollment. Five or 6 years (from preschool through second or third grade) is the maximum amount of intervention possible. The omitted category is 0 years of CPC intervention. Model 1 is again the main estimation equation of interest. The results indicate that student gender, family income, and parent education again are significant predictors of high school dropout. The results indicate that extended intervention for 5 or 6 years is associated with an 8 percent reduction in the probability of high school dropout. The results suggest that intervention for fewer years does not have a statistically significant effect on high school dropout probabilities, although the estimated coefficients are negative. As before, we next add school events into the analysis as potential predictors of high school dropout. As in Table 6, we find that school mobility, grade retention, and parental involvement are significant predictors of high school dropout. As

before, the statistical significance of the extended intervention variable is diminished by including these postprogram school events.

EXPLORING THE IMPORTANCE OF ATTRITION

Because we are missing information on school dropout or continuation for 25 percent of the original sample, we explore the possibility that nonrandom attrition may be a source of bias in our results. As in Reynolds and Temple (1998), we estimate an equation for sample attrition jointly with our dropout equations through use of a bivariate probit with selection model (Greene, 1995). The results are shown in Appendix Table 1.

Along with the dropout equation shown in Model 1 of Table 6, we estimate another probit equation for attrition where the dependent variable is equal to 1 if the student remains in the sample and is equal to 0 if the student is removed from the sample due to missing data on high school dropout. Out of the sample of 1,539, we had to remove eight students who had missing data on gender. As a result, the probit equation for attrition (or sample retention) is estimated with a sample of 1,531. The predictors of attrition include all the explanatory variables used in the dropout equation plus an additional variable that predicts attrition. The additional variable is the attrition rate for the other students in each student's kindergarten school. Conditional on the other included variables, this attrition rate of each student's kindergarten classmates predicts the student's own attrition but does not predict high school dropout.

Along with the equation for attrition, the probit equation for dropout is estimated with the sample of 1,159 for whom dropout status is known. The term labeled RHO in Appendix Table 1 is an estimate of the correlation in the error terms in the two equations. The positive sign of RHO reveals that the unmeasured predictors of high school dropout are positively correlated with the predictors of remaining in the sample of 1,159. In other words, students with unobserved characteristics making them more likely to drop out of school are also more likely to remain in the final sample of 1,159.

A statistically significant estimate of RHO would provide evidence that differential attrition exists and that selection bias due to nonrandom attrition may be present. However, this estimate of the across-equation correlation in the error terms is not statistically different from zero. The insignificance of RHO provides econometric evidence that there is no evidence of attrition bias caused by nonrandom attrition.

ADDITIONAL ANALYSES TAKING INTO ACCOUNT THE NESTED NATURE OF THE DATA

Because students in the study enrolled in 25 different intervention or comparison group sites, we also examined the importance of controlling for the nested nature of the data. As described in Seltzer (1994) and Temple (1998), it may be important to control for the possibility that the students within each site may have correlated error terms. The regression results reported in Tables 6 and 7 are based on the assumption that the individual students have error terms that are independent of each other. Students located within the same site, however, may have some unmeasured characteristics in common. As a result, they may share a common variance.

The regressions reported in Tables 6 and 7 were reestimated allowing for within-kindergarten-site correlations in the error terms. This estimation was conducted using a random effects probit model in LIMDEP (Greene, 1995). Those results, though not shown here, suggest no evidence of any within-site correlation in errors. Specifically, the null hypothesis of no correlation in the error terms of students located in the same kindergarten sites could not be rejected at the 5 percent level of significance.

POSSIBLE INTERACTION EFFECTS OF THE INTERVENTION PROGRAM

The regression results reported in first columns of Tables 6 and 7 suggest that participation in the CPC program beginning in preschool is associated with a lower probability of high school dropout. In

subsequent analyses, we investigated whether the estimated effect of the intervention program varied for boys versus girls. We added sex-by-program interactions into the regressions reported in the tables. The findings, which are not reported here, indicate no differential effects of the program by gender. This is true with the program measures reflecting participation in the preschool program as well as with the program measure representing duration of the intervention program. The null hypothesis of no differential effect of the program by gender could not be rejected at the 5 percent level of significance.

We also explored the possibility that the intervention program yielded benefits that differed according to the educational attainment of the parents. This analysis was suggested by the findings in Table 5 that students who participated in the extended intervention for 5 or 6 years are more likely than other students to have parents who are high school graduates. We included program-by-parent-education interaction terms into the regression equations. We found no evidence of a differential effect of the program on high school dropout across families in which a parent was a high school graduate and families in which a parent had not graduated from high school.

SUMMARY

This research has investigated the factors associated with early high school dropout using a large kindergarten cohort in the Chicago Public Schools. Approximately 29 percent of the students in the kindergarten class of 1985–86 in 20 school sites have dropped out of school as of January in what would have been the senior year of high school. The report illustrates the predictors of dropout for a sample of 1,539 students. Because data on school progress are available for only 1,159 students (or 75 percent of the original sample), information is presented contrasting the characteristics of students with known school progress and unknown progress. The two groups do not differ with respect to family poverty (measured by eligibility for free school lunches), parent education attainment, and student achievement measured at the end of kindergarten. Econometric estimation that controls for unmeasured differences

between students who left the sample and students who remain indicates that differential attrition is not a concern.

An examination of the characteristics of students with known school progress information shows that the dropouts were more likely to have come from poor families and scored lower on the standardized word recognition test given at the end of kindergarten. The dropouts were less likely to have participated in the extended intervention program offered through the Chicago Child-Parent Centers in preschool through second or third grade.

Probit regressions indicate that family and student characteristics measured in the early school years predict high school dropout. Simple regressions indicate that variation in the probability of school dropout can be explained by the variation in participation in the CPC program. Participation in the extended program of early educational intervention for 5 or 6 years is associated with an 8 percentage point reduction in the probability of dropout (from 29 percent to 21 percent), which represents a 27 percent reduction in the rate of dropout. Participation in the preschool program reduced the risk of early school dropout from 29 percent to 22 percent, representing a 24 percent difference in dropout probabilities. Once other variables such as grade retention and school mobility are entered into the estimating equations, however, enrollment in the CPC program becomes statistically less significant. Because previous research using the CLS (Reynolds and Temple, 1998) has shown that participation in the CPC intervention reduces the probability of grade retention and frequent school mobility, we conclude that the effects of the early intervention come about by reducing the need for grade retention and school mobility and by increasing the likelihood of parental involvement in children's education. The relation between parental involvement in elementary school and high school dropout has not been investigated before in such a large data set.

The findings from a large urban sample that early and extended intervention can lower the probability of high school dropout are important because this kind of evidence is rare. As indicated by a

recent federal government report (U.S. General Accounting Office, 1997), little evidence on the longer-term effects of early intervention comes from studies that employ large samples. The existing research on early intervention and longer-term outcomes is more likely to come from small-scale model programs offered in the 1960s rather than larger-scale public service programs currently administered through human-service organizations and schools. Being one of few studies of the link between early intervention and school dropout, our research provides encouraging evidence about the long-term effects of large-scale public school programs like CPC. Our results indicating that extended intervention is strongly associated with a lower rate of early high school dropout supports the call in Zigler and Styfco (1993) for extending Head Start-like interventions into the primary grades.

Our study complements the previous study by Fuerst and Fuerst (1993) of the Chicago Child-Parent Center and Expansion Program and adds to the Fuerst and Fuerst findings by using a larger and more recent cohort of students and richer analytic methods.

APPENDIX TABLE 1

Estimated Effects of Participation in the Child-Parent Centers, Controlling for Attrition
(Bivariate Probit with Selection Estimates)

	Model 1 Probit Coefficient	Model 1 Marginal Effect	Model 2 Probit Coefficient	Model 2 Marginal Effect
Dropout Equation				
Constant	-0.56*	-0.15*	-0.70*	-0.15*
Female	-0.27*	-0.10 (3.57)*	-0.25*	-0.10 (3.57)*
Family low-income	0.32*	0.11 (2.32)*	0.31*	0.11 (2.30)*
Parent HS graduate	-0.27*	-0.09 (2.71)*	-0.25*	-0.09 (2.57)*
Missing information	0.03	0.02 (0.69)	-0.04	0.02 (0.67)
Participated in CPC preschool	-0.18*	-0.06 (2.21)*	—	—
CPC participation for 1 or 2 years	—	—	-0.08	-0.01 (0.31)
CPC participation for 3 or 4 years	—	—	0.02	0.00 (0.84)
CPC participation for 5 or 6 years	—	—	-0.18	-0.08 (2.11)*

(table continues)

APPENDIX TABLE 1, continued

	Model 1 Probit Coefficient	Model 1 Marginal Effect	Model 2 Probit Coefficient	Model 2 Marginal Effect
In-Sample Equation				
Constant	-1.39*	—	-1.37*	—
Female	0.11	—	0.10	—
Family low-income	0.01	—	0.00	—
Parent HS graduate	-0.02	—	-0.04	—
Missing information	-0.55*	—	-0.53*	—
1-attrition rate by site	3.05*	—	3.03*	—
Participated in CPC preschool	0.04	—	—	—
CPC participation for 1 or 2 years	—	—	-0.20	—
CPC participation for 3 or 4 years	—	—	0.04	—
CPC participation for 5 or 6 years	—	—	0.21*	—
RHO	0.18	—	0.49	—

N=1531.
The first half of the table reports the predictors of high school dropout. The second half of the table reports the predictors of remaining in the sample. RHO is the estimated correlation of the error terms of the two equations.
* denotes significance at the 5% level.

References

Alexander, K. L., D. R. Entwisle, and C. S. Horsey. 1997. "From First Grade Forward: Early Foundations of High School Dropout." *Sociology of Education* 70: 87–107.

Barnett, W. S. 1995. "Long-Term Effects of Early Childhood Programs on Cognitive and School Outcomes." *The Future of Children* 5(3): 25–50. <http://www.futureofchildren.org/lto/02_lto.pdf>

Benasich, A. A., J. Brooks-Gunn, and B. C. Clewell. 1992. "How Do Mothers Benefit from Early Intervention Programs?" *Journal of Applied Developmental Psychology* 13: 311–362.

Bronfenbrenner, U. 1974. "Is Early Intervention Effective?" *Teachers College Record* 76: 279–303.

Ensminger, M. E., and A. L. Slusarcick. 1992. "Paths to High School Graduation or Dropout: A Longitudinal Study of a First-Grade Cohort." *Sociology of Education* 65: 95–113.

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

Greene, W. H. 1995. LIMDEP, Version 7. Econometric Software, Bellport, NY.

Haveman, Robert, Kathryn Wilson, and Barbara Wolfe. 1998. "A Structural Model of the Determinants of Educational Success." In *The Distribution of Welfare and Household Production: International Perspectives*, edited by Stephen P. Jenkins, Arie Kapteyn, and Bernard M. S. van Praag. New York: Cambridge University Press, pp. 346–363.

Haveman, Robert, and Barbara Wolfe. 1994. *Succeeding Generations: On the Effects of Investments in Children*. New York: Russell Sage Foundation.

Karoly, L. A., P. W. Greenwood, S. S. Everingham, J. Hoube, M. R. Kilbourn, C. P. Rydell, M. Sanders, and J. Chieca. 1998. *Investing in Our Children: What We Know and Don't Know about the Costs and Benefits of Early Childhood Intervention.* Santa Monica, CA: Rand.

National Science and Technology Council. 1997. "A National Research Initiative for America's Children for the 21st Century." <http://www.whitehouse.gov/WH/EOP/OSTP/Children/Report.html>.

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

Reynolds, A. J., W. T. Miedel, and E. Mann. 1998. "Adopting Innovation in Early Intervention: The Chicago Child-Parent Center Program." Mimeographed. Waisman Center, University of Wisconsin–Madison.

Reynolds, A. J., and J. A. Temple. 1995. "Quasi-Experimental Estimates of the Effects of a Preschool Intervention: Psychometric and Econometric Comparisons." *Evaluation Review* 19: 347–73.

Reynolds, A. J., and J. A. Temple. 1998. “Extended Early Childhood Intervention and School Achievement: Age 13 Findings from the Chicago Longitudinal Study.” *Child Development* 69: 231–246.

Roderick, M. 1994. “Grade Retention and School Dropout: Investigating the Association.” *American Educational Research Journal* 31: 729–759.

Schweinhart, L. J., H. V. Barnes, D. P. Weikart, W. S. Barnett, and A. Epstein. 1993. *Significant Benefits: The High/Scope Perry Preschool Study through Age 27*. Ypsilanti, MI: High/Scope Press.

Schweinhart, L. J., and D. P. Weikart. 1988. “The High/Scope Perry Preschool.” *14 Ounces of Prevention: A Casebook for Practitioners*, edited by H. L. Price et al. Washington, DC: APA.

Seltzer, M. H. 1994. “Studying Variation in Program Success: A Multilevel Modeling Approach.” *Evaluation Review* 18: 342–361.

Temple, J. A. 1998. “Evaluation Using Secondary Data.” *Advances in Educational Productivity*, vol. 7: *Evaluation Research for Educational Productivity*, edited by A. Reynolds and H. Walberg. Greenwich, CT: JAI Press, pp. 219–239.

U.S. Department of Education. 1997. “Dropout Rates in the United States, 1996.” NCES 98-250, Washington, DC: National Center for Education Statistics.

U.S. General Accounting Office. 1997. “Head Start: Research Provides Little Information on Impact of Current Program.” HEHS-97-59, Washington, DC.

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