Poverty and Early Childhood Educational Intervention

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Introduction and Summary of Results

Poverty's negative effect on children's development has been examined by numerous scholars over the past half-century (e.g., Broman, Nichols, & Kennedy, 1975; Brooks-Gunn & Duncan, 1997; Evans, 2004; Huston, McLoyd, & Garcia-Coll, 1994; Hunt, 1969; McLoyd, 1998; Smith, Brooks-Gunn, & Klebanov, 1997; Taylor, Scarr & Weinberg, 1981). Childhood poverty is associated with higher rates of academic failure or grade retention (Bendersky & Lewis, 1994; Brooks-Gunn & Duncan, 1997; Pagani, Boulerice, & Tremblay, 1997; Patterson, Kuperschmidt, & Vaden, 1990), and higher incidences of school dropout (Cairns, Cairns, & Neckerman, 1989; Lamb, Land, Meadows, & Traylor, 2005). Adolescent parenthood is higher among poor teenagers (Klerman, 1991; Lamb, Land, Meadows, & Traylor, 2005), and children raised in poverty have poorer employment records as adults (see Lamb, Land, Meadows, & Traylor, 2005). Further, an increased likelihood of smoking and illegal drug use is associated with poverty (Klerman, 1991).

Within the US, poverty and minority status are confounded such that African American children are at increased risk on two fronts. They are confronted with racism in many aspects of their lives, and African Americans have lower incomes, about 60% of that of the country as a whole (Allen & Majidi-Ahi, 1998; Glick, 1997). In the US Census Bureau 2005 report (Denavas-Walt, Proctor, & Lee, 2006), 33% of African-American children under the age of 18 lived in households below the poverty level compared to 10% of White children. Not only are African American children more likely to experience poverty at some point while growing up, they are also more likely than White children to experience long-term poverty (Corcoran & Chaudry, 1997; Duncan et al., 1994; Giachello & Aarom, 2002).

In an attempt to redress the negative consequences of poverty on children's development, a number of early childhood programs have been instituted over the years. Using a variety of service delivery models, many of these programs offered child-centered intellectual stimulation early in the life span based on the theory that early experience exerts a differentially strong influence on developmental outcomes (e.g., Hunt, 1969). A comprehensive examination of the long-term effects of several such efforts was conducted by the Consortium for Longitudinal Studies (Lazar, Darlington, Murray, Royce, & Snipper, 1982), which found that, although IQ differences and enhanced reading and mathematics scores did not persist past sixth grade, early intervention significantly reduced the likelihood of grade retention and the use of special education among those treated.

More recently, other early intervention programs have reported even longer-term outcomes for their programs, extending into young adulthood. These include the Chicago Child-Parent Center Program (Reynolds, 2000), the Infant Health and Development Program (McCormick et al., 2006), and the Perry Preschool Program (Schweinhart, Barnes & Weikart, 1993; Schweinhart, Montie, Xiang, Barnett, Belfield, & Nores, 2005). (The latter is the only one of the three that was also a member of the Consortium for Longitudinal Studies). A fourth program, the Abecedarian Project, is one of the most intensive early childhood programs ever provided for poor children. Extending its preschool treatment from early infancy through age five, its long-term, young adult effects are the focus of this policy brief. The main long-term findings for the Abecedarian program include enhanced academic achievement, a greater likelihood of going to college, a reduction in teenaged parenthood, greater likelihood of obtaining skilled employment as a young adult, a trend for reduced smoking, and reduced use of marijuana (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002). In addition, this

brief describes a cost-benefit analysis of the Abecedarian program which found an estimated benefit-cost ratio of 2.5:1 (Barnett & Masse, in press).

In this policy brief, we first review literature concerning the long-term effects of early intervention for poor children. Next, the scope of the problem addressed here is demonstrated with descriptive statistics concerning the associations between poverty and key young adult outcomes. Findings from the young adult follow-up of the Abecedarian participants are then described, along with estimates from the cost-benefit analysis. The brief concludes with implications of these findings for today's young children and directions for future work in this area.

Literature Review: Research on Educational Intervention for Poor Children

Bronfenbrenner and Ceci (1994) suggested that by enhancing the quality of environments and the proximal processes that are experienced in these environments, it is possible to increase the extent to which an individual develops to his or her fullest potential. Early childhood educational intervention represents one major way that scientists and educators have attempted to promote such enhancement of the development of poor children. Much research has been devoted to examining the short- and long-term benefits of early childhood education.

Evaluations of the most widely provided preschool program for poor children, Project Head Start (Zigler & Muenchow, 1992) showed, first, in a famous but controversial evaluation by the Westinghouse Learning Corporation (Cicirelli, 1969), and later, in the Head Start Synthesis Report (McKey et al., 1985), that Head Start appeared to have had virtually no lasting impact on poor children's school performance. However, much of the Head Start research was not well controlled. Assignment to treatment and control groups was not random, and there was inconsistency in program delivery. More recently, a nation-wide study of Head Start did use a

random assignment design and found, for outcomes assessed after one year of program participation, small to moderate effects for language and pre-reading outcomes, no significant effects for math outcomes, and small to moderate effects for access to health care (Puma, Bell, Cook, Heid, & Lopez, 2005). This study is ongoing with future reports expected.

A Consortium for Longitudinal Studies (Lazar, Darlington, Murray, Royce, & Snipper, 1982) was formed by investigators of several early childhood programs conducted in the 1960s to follow up their participants 6-10 years after the termination of treatment. Limiting their sample to programs that met high standards of scientific control, the Consortium reported that a significant reduction in the use of special services in school and fewer retentions in grade for treated individuals compared with controls were robust findings across studies. However, intellectual gains related to early childhood programs eroded within 3-4 years, and academic gains were largely gone after 5 or 6 years in school.

Recent work is examining the very long term effects of well-controlled early childhood programs, investigating issues of “real-life” benefits as participants approach adulthood and beyond. The Chicago Child-Parent Center Program provided educational intervention in a center-based program that offered child and family support services to a sample of families living in high-poverty neighborhoods (Reynolds, 2000). The program included half-day preschool for children at ages 3 and 4, as well as other program and family components in kindergarten and additional school support through first grade. The original sample included 1,539 children (989 program participants and 550 comparison children). Program participation was found to be associated with cognitive gains when the children began formal schooling and higher achievement scores during elementary school (Reynolds et al., 2001). In a follow-up study at age 20, the sample included 805 to 911 program participants and 421 to 493 individuals

in the comparison group, depending on outcome (no evidence of selective attrition was found). Contrasted with comparison children who did not receive the preschool intervention, preschool program participants had a lower incidence of crime at age 18 and higher rates of high school graduation by age 20 (Reynolds et al., 2001).

Another program that has demonstrated long-term effects is the Infant Health and Development Program. A follow-up of individuals who took part in this early childhood intervention program was recently reported by McCormick, et al., (2006) who examined age-18 outcomes among its participants. This study enrolled 985 low-birth-weight infants born at eight sites around the US. At all sites infants were randomly assigned to receive home-based educational intervention during their first year followed by two years of child care-center based intervention up to age three, or to a follow-up only group who had all the services typically offered for low-birth weight children within their communities but who lacked the systematic early childhood educational effort. Treatment benefits varied according to the initial weight of the babies. Heavier treated infants demonstrated large effects of treatment on cognitive test performance at age three (14 IQ points, effect size of .83), while the lighter treated infants showed moderate treatment effects (7 IQ points, effect size of .41). By age 8, the treatment effect on cognitive test performance of the heavier infants had decreased to 4.4 points, while no significant program effect was found for those initially lighter in weight. At age 18, long-term outcomes were compared among the treated and follow-up only participants, with approximately 2/3 of the original participants taking part. At this age, treated individuals who were initially heavier showed continued benefits in terms of higher cognitive scores of approximately the same magnitude seen at age 8, and fewer reported problem behaviors. No long-term treatment benefits were found for the lighter weight group (McCormick et al., 2006).

The most extensive long-term reports to date are from the Perry Preschool Program whose investigators have now followed-up their participants at ages 27 and 40. In this program, children received early educational intervention in a preschool setting for half-days, during the school year, at ages 3 and 4. The original study sample consisted of 123 individuals from low-income families. Although significant program effects were found for cognitive test scores through first grade, this difference was no longer significant by second grade (Weikart, Bond, & McNeil (1978). However, program participants did have significantly higher achievement scores and were less likely to receive special education services in school (Schweinhart & Weikart, 1980). At age 27, 116 (95%) of the original participants were followed up, and at age 40, 112 (81%) of the sample was interviewed. At age 27, Schweinhart and his colleagues found that individuals with preschool treatment were more likely than controls to be high school graduates, had significantly higher earnings, were more likely to own homes and second cars, and were less likely to need welfare or to be involved in criminal activity (Schweinhart et al., 1993). At age 40, they found that those who attended the Perry Preschool Program were more likely to be employed, earned higher salaries, were more likely to own homes, and were more likely to have savings accounts. A reduction in crime could still be detected, and a reduction in illegal drug use was also reported for the 40-year-olds (Schweinhart et al., 2005). No other experimental study of early intervention to date has such long-term findings to report.

A fourth program, the Abecedarian Project, is unique in that it represents the most intensive early childhood educational program yet offered for children from poor families that has both a rigorous, experimental design and follow-up information into young adulthood. The study enrolled 111 infants between the years of 1972 and 1977, with 57 being randomly assigned to receive center-based early educational intervention and 54 in a control group that did not

receive the early educational treatment. It is the only program to have begun its center-based program in infancy and to continue it through entry into kindergarten, and whereas most other preschool programs were half-day and provided only during the school year, this program was full-day and year-round. Thus, the extent of the program was similar to the hours in care experienced by many children who enter child care arrangements as infants and continue until school entry. However, the educational intervention program was quite different from what is typically provided in child care settings. The young adult outcomes of the Abecedarian project form the core of this policy brief (Campbell, Ramey, Pungello, Miller-Johnson, & Sparling, 2002)[1].

Descriptive Statistics: Childhood Poverty and Young Adult Outcomes

Much work has demonstrated that children raised in poverty are more likely to experience a number of negative outcomes as young adults. The young adult follow-up study of the Abecedarian Project sample found outcomes in several of these domains to be related to program participation. These include demonstrated academic achievement, college attendance, teenage parenthood, a trend for smoking, and marijuana use. Before turning to the findings from the Abecedarian study, the associations between poverty and these factors are reviewed.

Academic achievement. A consistent finding from research examining the effects of poverty on children's development is that children raised in poverty have poorer achievement outcomes than other children. Research has found early childhood poverty to be associated with poorer early school achievement (e.g., Smith, Brooks-Gunn, & Klebanov, 1997) as well as poorer achievement in adolescence (Lipman & Offord, 1997). A recent study by Dahl and Lochner (2005) estimated the effects of family income on reading and math achievement scores

[1] These outcomes are presented with permission of the Journal of Applied Developmental Science.

specifically. These researchers found that every thousand dollars increase in family income was associated with an increase of 3.6% of a standard deviation in reading test scores and an increase of 2.1% of a standard deviation in math test scores.

College attendance. Individuals who attend a 4-year college or university have stronger earnings potential than those with a high school diploma and those who attend community college or vocational schools (Ceci & Williams, 1997). Thus, college attendance has the potential to help break the cycle of poverty. However, studies have found that children raised in poverty are less likely to attend college. A US Department of Education report found that while 88% of affluent students attend college, only 36% of children raised in poverty do so (Howard, 2001). In addition, greater years of poverty are associated with poorer outcomes in this domain. Teachman, Paasch, Day, and Carver (1997) found that compared to adolescents who did not live in poverty, those who had spent one to three years of adolescence living in poverty were 40% less likely to attend college while those who had spent four years of adolescence living in poverty were 60% less likely to attend college.

Teen parenthood. Young people growing up in disadvantaged economic, familial and social circumstances are more likely than their better-off peers to engage in risky behavior and to have a child during adolescence (Boonstra, 2002). In Britain, a number of longitudinal studies have shown that poor girls and those from generally less propitious backgrounds are more likely to become teenage mothers (Kiernan, 1980, 1995, 1997; Hobcraft, 1998). The United States has the highest teen pregnancy rate in the fully developed world (Connolly, 2005). Teenaged parenthood is strongly associated with less advantageous outcomes later in adult life (Kiernan 1980, 1995; Wellings et al. 1996). Adolescents who become pregnant are more likely to drop out of school, which in turn leads to lower-paying jobs. Further, the research shows that children

born to teenage mothers themselves have poorer health and academic outcomes (Annie E. Casey Foundation, 2003; The National Campaign to Prevent Teen Pregnancy, 2004).

Smoking and illegal drug use. Smoking cigarettes is associated with poverty as well. According to the CDC National Center for Chronic Disease Prevention and Health Promotion (2004), while 20.6% of individuals living above the poverty line smoke cigarettes, 29.1% who live below the poverty line do. Results from the 2005 National Survey on Drug Use and Health survey found that education and employment, two factors associated with poverty, are associated with smoking as well. While 34.8% of individuals over 18 who did not finish high school reported smoking cigarettes, 31.8% of high school graduates and 13.8% of college graduates did so. Concerning employment, while 43.8% of unemployed individuals smoked cigarettes, 28.3% of those working full-time and 25.2% of those working part-time did so. Similarly, this survey found illegal drug use to be associated with education and employment levels. Among young adults, 10.2% of those who had not graduated high school reported drug use or dependence while 9% of those who graduated high school and 8% of those who graduated college did so. Concerning employment, while 17.6% of unemployed adults reported drug use, 11.2% of those employed part-time and 10.2% of those employed full-time did so.

In sum, poverty is associated with a variety of poor outcomes. Compared to other children, children raised in poverty have lower achievement scores on average during the school years and are less likely to attend college as they make the transition into adulthood. These poorer scholastic outcomes may in turn be associated with worse employment outcomes in young adulthood. Further, children raised in poverty are more likely to become teenage parents than other children, and cigarette smoking and illegal drug use are associated with lower

education and employment levels. Given the number of domains that are affected, programs that can enhance developmental outcomes for children raised in poverty are needed.

Analyses from the Abecedarian Young Adult Follow-up Study

The Abecedarian project was developed to examine the extent to which the progressive decline in cognitive test performance typically seen in children raised in poverty (Heber, Dever, & Conry, 1968) could be prevented or reduced by providing a high quality early learning environment (Ramey & Campbell, 1984). Analyses examining the effects of the program during its implementation and in follow-up studies through adolescence found significant effects of the program. Children who received the early intervention earned significantly higher scores than controls on intellectual measures from the age of 18 months throughout the preschool period (Ramey & Campbell, 1984). The intervention children also earned higher average scores on cognitive tests as well as on reading and mathematics achievement tests during the early school years (Ramey & Campbell, 1991), at age 12 (Campbell & Ramey, 1994), and age 15 years (Campbell & Ramey, 1995). In addition, students with the early childhood treatment had significantly fewer placements into special education and retentions in grade. Given these positive earlier findings, effects of the early educational intervention on young adult outcomes were examined.

Method

Sample

Starting with pilot research in 1971 and enrollment of subjects in 1972, the Abecedarian Project has provided a prospective, in-depth study of the lives of multi-risk families and their children. Local social service agencies and prenatal clinics helped to identify potential participants. Selection criteria were based on thirteen sociodemographic factors that were weighted and

combined to create a High Risk Index (Ramey & Smith, 1977). In addition, infants had to appear free of biological conditions associated with mental, sensory, or motor disabilities.

Four cohorts of families were enrolled in the study between 1972 and 1977. During admission, recruited pairs were matched on High-Risk Index scores, then randomly assigned to the intervention or control group. A total of 109 eligible families, to whom 111 infants (1 set of identical twins, one sibling pair) were born, accepted their random assignments and agreed to take part. Fifty-seven infants (28 females and 29 males) were assigned to the intervention group and 54 (31 females and 23 males) to the control group. The characteristics of families in the two groups were very similar. All families met poverty guidelines. The typical mother was young (mean equal to 20 years old), had less than a high school education (mean equal to 10 years), was unmarried, lived in a multigenerational household, and reported no earned income. A third received public assistance. Ethnicity was not a selection factor, but of those who took part, 98% were African American due to the confound between poverty and ethnicity at the time and place of participant recruitment.

Early Childhood Intervention

The service delivery model was child-centered, with treated children having full-day educational child care year round. A systematic curriculum involving educational "games" that emphasized the development of skills in cognition, language, and adaptive behavior was provided (Sparling & Lewis, 1979, 1984, 2000). The infant games consisted of simple, age-appropriate, adult-child interactions that included talking to the child, showing toys or pictures, and offering infants a chance to react to sights or sounds in the environment. Activities were individualized for each child by the staff. As children grew, the educational content became more conceptual and skill-based. The curriculum was more group-oriented for older

preschoolers. Language development was especially emphasized. However, children always had freedom to choose activities, and the emphasis on individual development was paramount throughout. An additional feature of the treatment program was that children attending the child care center had their primary pediatric care on site. A medical team comprised of pediatricians, a Family Nurse Practitioner, and a medical aide did well-baby check ups and monitored the health of the children every day. Low-cost medical care was available to control group families at local hospitals or public health clinics.

Families in both the intervention and control groups received supportive social services as needed. Control infants had nutritional supplements for the first 15 months of life to control for the fact that program children received much of their early nutrition at the center. Although control group children did not receive systematic educational intervention (e.g., Ramey et al., 1976; Ramey & Campbell, 1984; Ramey & Campbell, 1987), a number of them attended other child care centers, some entering in infancy, others later in the preschool years (Burchinal, Lee, & Ramey, 1989). Thus, the group comparisons are between children who received the Abecedarian early educational intervention and others reared in the local ecology for low-income families at that time and place (i.e., either at home or in the variety of childcare settings utilized by local low-income families). In fact, if a child in the control group evinced developmental lags, the Abecedarian staff referred his or her family to local resources such as developmental evaluation clinics, Head Start, community preschools, or other specialized preschool programs for children showing delays. Families in both the treated and control groups received supportive social work services in emergency situations (fortunately rare). As a result, the treatment control differences found for the study participants may well be conservative.

Although not a focus of this report, it should be noted that the early treatment and control groups were re-randomized into school-age treatment and school-age control groups when children entered public kindergarten at age 5, with half of the treated group and half the control group being assigned to receive primary grade intervention in the form of a home-school resource teacher for the first three years the child attended public school. Because the findings from this program showed that the early childhood intervention (age 0-5) exerted a more powerful effect on cognitive and academic outcomes than did the later intervention (5-8 years), the focus of this young adult follow-up study has been on the long-term effects of the early educational intervention delivered in the child care setting.

Attrition and young adult sample

At age 21, 105 of the original 111 infants were living and eligible for follow-up. One male and one female in the treated group were deceased and one female proved to be ineligible for inclusion. One female in the control group was withdrawn from the study and two females in that group were deceased. Of the 105 remaining individuals, all were located and 104 took part (one declined), giving an overall retention rate of 93.7% of the original infant participants, and 99% of those living and eligible at this age.

Procedures

The investigators were fortunate to have retained the services of the study's original Family Coordinator, whose extensive knowledge of local kinship networks was an invaluable asset in the recruitment of families for the young adult follow-up. Young adults and their parents were contacted separately by letter and invited to enroll in this phase of the study. The target assessment date was one month on either side of the young adult's 21st birth date. Over two thirds of the sample was assessed during this time window, the rest, with four exceptions, within

a year. Project funds enabled individuals living out of state to return for assessments, although in rare instances, the assessor traveled to the participant instead. Data collection for young adults included administration of standardized tests, questionnaires, and an interview. Assessors were unaware of the participants' early treatment histories. Assessors included African American as well as White individuals.

Measures. The Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R; Woodcock & Johnson, 1989) was used to assess academic skills in reading and mathematics due to its demonstrated high levels of reliability and validity and because its norms include African Americans in proportion to population representation. Broad Reading scores were based on subtests labeled Letter-Word Identification and Passage Comprehension; Broad Mathematics subtests included Calculation and Applied Problems.

A Young Adult Interview (YAI) was devised locally, covering such topics as living circumstances, family composition, educational and vocational history, leisure and recreational activities, community involvement, and any involvement in lawbreaking. The young adult described educational attainment in terms of when and where he or she finished high school or obtained a GED certificate, and all educational attainments post high school: community college, vocational schools, or 4-year colleges or universities attended. He or she also described current employment in terms of the current position and gave a history of previous jobs. The jobs held were coded according to the Hollingshead Index of Social Class (Hollingshead, undated). "Skilled" employment is defined as a rating of four or higher on this scale (electrician is one example of a job rated four on the Hollingshead scale).

Substance abuse questions were taken from the Youth Risk Behavior Survey (Center for Disease Control, 1992). This Survey covers a variety of behaviors associated with injury or

illness in young adults. Substance use items covered use of alcohol, binge drinking of alcohol (5 or more drinks in a row), smoking tobacco, the use of marijuana in the past month, lifetime use of cocaine, and use of "any other type of illegal drug or controlled medication without a doctor's prescription."

Data Analysis

An intent-to-treat analysis plan was followed in which each individual who participated in the follow-up was analyzed according to his or her original preschool (N = 104) random assignment, regardless of the length of exposure. This has the advantage of increased stringency while at the same time increasing detection power by increasing the number of individuals available for analysis.

General Linear Models (GLMs) were used to examine treatment effects for continuous outcome variables with treatment group and gender as predictors. For categorical variables, chi-square analyses were used. To check for the effect of less exposure to treatment on reading and math achievement, post-hoc analyses were then conducted with data from five individuals originally assigned to the preschool treatment group removed from the sample. All these individuals left the program before the age of three years, four of them by age one. This permitted an exploration of the degree to which amount of treatment might have been a crucial aspect of the preschool program. However, because this procedure violated random assignment (in that control group individuals similarly lacking preschool data were retained in the sample), maternal IQ was covaried in these analyses in an effort to reduce any resulting selection bias. The findings indicated that the positive effect of treatment seen for reading and math achievement was seen with or without the data for the five individuals removed and mother IQ

covaried. We thus concluded that the outcomes reported below are similarly free of bias related to early attrition among the treated individuals.

Results

Key outcomes in terms of educational, vocational, and social adjustment indices showed that benefits of the early educational intervention were detectable in young adulthood. These results are summarized in the following table:

Young Adult Outcomes

Outcome	Treated Group	Control Group	Test Statistic
Reading Achievement (Academic Grade Equivalent)			F=6.48*
M	11.1	9.3	
SD	4.2	3.1	
Math Achievement (Academic Grade Equivalent)			F=4.12*
M	9.2	7.9	
SD	3.3	3.0	
Years of Education			F=5.0*
M	12.2	11.6	
SD	1.5	1.4	
% in School at 21	42	20	X^2=5.85*
% Ever Attended College	36	14	X^2=6.78**
% in Skilled Employment	47	27	X^2=4.50*
Age When First Child Born			F=5.26*
M	19.1	17.7	
SD	2.1	1.5	
% Teen Parent	26	45	X^2=3.96*
% Smoke Tobacco	39	55	X^2=2.52++
% Used Marijuana	18	39	X^2=5.83*

**p<.01, *p<.05, +p<.10, ++p<.15

Note: Treatment n=53, Control n=51, with the exception that 2 treated individuals declined to reply to law breaking and 2 treated individuals declined to reply to drug use, thus for these items treatment n=51.

Academic achievement. Using Grade Equivalent (GE) scores as the outcome, individuals in the treated and control groups differed significantly on Woodcock-Johnson Broad Reading and Broad Mathematics scores. For reading, the mean GE was 11.1 years (*SD* = 4.2) for the treated group and 9.3 (*SD* =3.1) for the control group, F (1, 100) = 6.48, $p < .05$. For mathematics, mean GE score was 9.2 (*SD* = 3.3) for the treated group and 7.9 (*SD* = 3.0) for the control group, F (1, 100) = 4.12, $p < .05$. Thus, those young adults who had experienced early treatment earned grade equivalent scores 1.8 years higher in reading and 1.3 years higher in math than did those in the control group. No significant main effects for gender or significant interactions between treatment and gender were found. Recalculating these scores after removing the data for the five minimally treated cases did not obviate the treatment/control difference for the reading GE (F (1, 92) = 7.15, $p < .01$), but the size of the treatment/control difference in math was slightly reduced (F (1, 92) = 3.80, $p < .10$).

Educational attainments. Treated individuals completed significantly more years of education by age 21 than did controls, F (1, 99) = 5.00 p < .05. The mean years of education was 12.2 (*SD* = 1.5) for the treated group and 11.6 (*SD* = 1.4) for the control group. Although there was not a significant main effect for gender, the interaction of treatment by gender was significant, F (1, 99) = 4.19, $p < .05$. Treated females earned 1.2 more years of education (*M* = 12.6 years, *SD* = 1.6 years) than control females (*M* = 11.3 years, *SD* = 1.4 years). Males, in contrast, earned almost identical amounts of education irrespective of early childhood treatment (*M* = 12.0 years, *SD* = 1.5 years for those with early treatment compared with *M* = 11.9 years, *SD* = 1.3 years for those without). Individuals with early treatment were also significantly more likely to be in school at age 21; 42% of those with early treatment were currently in school compared with 20% of controls, X^2 (1, *N* = 104) = 5.85, $p < .05$. Most important, almost three

times as many individuals in the treated group (35.9 %) compared to the control group (13.7 %) had attended, or were still attending, a 4-year college, X^2 (1, N = 104) = 6.78, $p < .01$.

Skilled employment. Individuals in the treated and control groups did not differ significantly in the percent employed but did differ significantly in the level of employment they reported. Based on Hollingshead scores of 4 or higher, young adults with early treatment were more likely to be engaged in skilled jobs: 47% of treated individuals compared with 27% of the controls, X^2 (1, N = 100) = 4.50, $p < .05$.

Parenthood. Few of the young adults in the Abecedarian sample were married at age 21. Only seven had married when interviewed (five females, two males), and one male was by then separated. Four of the seven were among the 46 individuals who had one or more children. Within this sample, females tended to have more children than males, F (1, 103) = 3.09, $p < .10$. In all, 40 children had been born to females compared with 24 reported by males. There was not a significant effect for treatment or a significant gender by treatment interaction for the number of children born. Descriptively, 56% of the females in the treatment group reported having no children by age 21, compared with 43% of control females. Of the 44% of treated females (n = 11), who had a child, only three had a second child and none had a third; of the 57% (n = 16) of females in the control group who had a child by age 21, six had a second child and two had a third. Almost twice as many children were born to females in the control group (26 in all) as to females in the treated group (14 children in all). The percent of treatment and control group males with children was similar: 36% of treated males compared with 39% of control group males reported having children at age 21. Twelve children in all were born to 10 treated males and 12 to 9 control males.

Early treatment was significantly associated with the average age at the birth of the first child. The mean age at first birth was 19.1 years (*SD* = 2.1) for the treatment group compared with 17.7 years (*SD* = 1.5) for the control group, F (1, 41) = 5.26, $p < .05$. It must be noted, however, that the youngest age at first reported parenthood in both groups was 15 years old. Defining a teen parent as one aged 19 or younger when a first child was born, treatment was associated with a significant reduction in teen parenthood (26% of those treated compared with 45% of controls had children as teens), X^2 (1, N = 104) = 3.96, $p < .05$.

Smoking and illegal drug use. There was a tendency toward a reduction in smoking for those with early childhood educational treatment; 39% of the treated group and 55% of the controls described themselves as regular smokers, X^2 (1, N = 102) = 2.52, $p = .11$. Marijuana use within the past 30 days was significantly less among the treated individuals; 18% percent of the treated group cited some level of usage during that period, compared to 39% of controls, X^2 (1, N = 102) = 5.83, $p < .05$.

Non-significant findings. Young adult outcomes for which no significant differences between the early treatment and control groups were found included high school graduation rate, employment rate (unskilled or skilled combined), percent married, reports of alcohol use and abuse, cocaine and other illegal drug use, and criminal activity (self-report of misdemeanor and felony convictions). See Campbell et al., 2002 for details.

Cost-benefit Analysis

Economists external to the program have calculated cost-benefit ratios for the Abecedarian program. A complete explanation of the method they used is given in Masse and Barnett (2002). In brief, costs were estimated on the basis of records kept by the University and the program operators; benefits were estimated in seven categories: (1) earnings and fringe

benefits of participants; (2) earnings and fringe benefits of future generations; (3) maternal earnings; (4) elementary and secondary education cost-savings; (5) improved health; (6) higher education costs; and (7) welfare use.

Total cost of the program (in 2002 dollars) was estimated at $67,000 per child.[2] Given that treated children were more likely to attend college, an increased cost of higher education was estimated at $8,128. On the other hand, due to increased educational attainment, the benefits of increased lifetime income were estimated to be $37,522. In addition, the program was estimated to increase the earnings of future generations (i.e., children of the participants) by $5,700 due to such factors as enhanced cognitive functioning and achievement, greater educational attainment, and timing and spacing of when the children were born. An estimated benefit of $68,278 was found due to increased earning of the mothers of the program participants. Having their children receive free, high-quality care from infancy through age 5 allowed the mothers to make greater progress in terms of educational and occupational success. Cost savings were also found for K-12 schooling in the forms of reduced special education placements and fewer grade retentions resulting in an estimated benefit of $8,836. Due to the reduced smoking rates, an estimated benefit of $17,781 resulted. Finally, an estimated benefit of $196 was found for reduced costs from welfare administration. All totaled, the estimated benefits per child were calculated at $158,278 giving an estimated benefit-cost ratio of 2.5:1 (Barnett & Masse, in press).

Conclusions and Suggestions for Future Research

The young adult findings from the Abecedarian study show that intensive early childhood educational intervention made a dramatic difference in long-term outcomes for children raised in

[2] In this analyses, discount rates of 3%, 5%, and 7% were used. In each case, the project demonstrated benefits; analyses from the 3% rate are presented here.

poverty. Those who experienced the educational intervention earned higher average scores on standardized tests of academic achievement in both reading and mathematics than similar young adults who did not receive the early treatment, and they were more likely to attend a 4-year college or university. They held higher skill level jobs, and they were less likely to have been a teenage parent. Individuals with early childhood intervention showed a strong trend toward a reduction in tobacco smoking, and they were less likely to use marijuana. Further, as shown in the cost-benefit analysis, although the cost of providing poor children with multi-year full-time educational child care was relatively high, the estimated benefits outweighed the costs by more than two to one.

Certain caveats must be noted that limit the interpretations that can be made concerning these data. First, the sample size is small reducing the power to detect significant relationships. Second, the sample included mostly African-American children raised in low-income households, limiting the generalizability of the results. In addition, the university setting in which the intervention took place is unique, and the intense, high-quality program that was provided is not typical of the experiences of children in most child care settings. However, despite these limitations, the data do suggest that in such enhanced circumstances, early learning experiences can have very long-term impacts for disadvantaged children.

Future work in this area needs to examine the impact of early educational intervention farther into the life span. To date, only the Perry Preschool Project has follow-up data well into adulthood. The finding of better educational outcomes for young adults who had been in the Abecedarian early childhood treatment group suggests that the program may have continued effects into their adult lives. At 21 years of age, those who went to college had not yet had a chance to graduate, so the ultimate benefit of their better educational progress remains to be

demonstrated. Currently, the individuals in this study are participating in an age-30 follow-up; this work is being supported by the Maternal and Child Health Bureau and the National Institutes of Health. The emphasis of this follow-up study is on vocational outcomes and economic indicators. In addition, this study is exploring outcomes in the children of program participants. For all offspring aged 3 and up, individual assessments of school readiness or academic achievement are being administered. The quality of the home environments provided by the parents is also being measured. Thus, both longer-term effects into adulthood as well as intergenerational effects are being examined. Other studies of early educational intervention for poor children need to follow-up their participants farther into adulthood as well in order to gain a better picture of the long-term effects of such programs.

Another area for future work concerns identifying program features responsible for the effects of early educational intervention. The long-term effects found to date vary among the programs that have been followed-up extensively. For example, where as the Abecedarian project found significant cognitive as well as achievement differences in young adulthood, no significant differences were found for criminal activity. In contrast, while Perry Preschool did find a crime effect for their program, cognitive ability differences were no longer significant by the early school years.

Several factors vary among the intervention programs that may impact program results (Bryant & Maxwell, 1999). One such factor is the type of model used. For example, while the Abecedarian program employed a center-based program during infancy, IHDP used a home-based program for the first year of life and a center-based program for the next two years, and the Chicago Child- Parent Center program combined two years of preschool with parent supports and later learning supports in the early grades. In addition, the curriculum used varied

considerably among the programs. Whereas Abecedarian and IHDP used Learningames, the other programs used different curricula. Intensity (hours in the program per year) also varied among the studies. While the Abecedarian project was the most intensive, providing full-time care year round, others, such as the Perry Preschool, followed a more typical preschool format of half-days during the school year. Two factors that are quite confounded in this work are child age and duration. While some programs such as Abecedarian and IHDP began their interventions in infancy, others such as the Perry Preschool and the Chicago Child-Parent Center Program began at age 3. Duration refers to length in years of treatment. While the Abecedarian center-based program lasted for 5 years (infancy until kindergarten entry), Perry Preschool lasted for two years (ages 3 and 4). Given the several factors that vary among the programs, determining which factors created the lasting effects is difficult. The long-term effects of the Abecedarian program may be due to the fact that the program was center-based, used the specialized curriculum developed for the program, was full-time and year-round, began in infancy, lasted for 5 years, or a combination of some or all of these factors. Future research is needed in which confounds among these variables are reduced and the mechanisms by which the effects are produced are identified.

Future work is also needed in which cost/benefit analyses are conducted for other programs. Barnett and Masse (in press) note that only one other randomized trial of early childhood education has both long-term follow-up data and cost-benefit figures. The Perry Preschool found that its treated participants had fewer placements into special education, better adult employment, and a reduction in crime compared with controls. The estimated benefit:cost ratio was 9:1, that is, $9 saved for each dollar spent. This is considerably larger than the ratio of 2.5:1 found for the Abecedarian study. Possible reasons might be that the Perry Preschool

program was less expensive, involving two years of half-day preschool compared with five years of full-time child care, and the finding that the Abecedarian study sample did not show a treatment effect for lawbreaking, which is by far the largest component of the benefit for the Perry study.

The positive findings from this study have important policy implications. They show that early educational intervention delivered in a high quality, child care setting can have a lasting impact on the academic performance of children from poverty backgrounds. While not every child who attended the program went on to attend college in the late teens, the probability of going to college or university was increased three-fold for those who had the early childhood experience. Given the randomized nature of the Abecedarian study and the fact of its very low attrition rate, it is fair to attribute this benefit to the intervention itself. Other factors, such as family support undoubtedly also contributed to this significant achievement, but the early treatment clearly improved the odds of making it to that level.

Specific policy implications of the findings concern access to high quality early care environments for young children raised in poverty. Clearly, the effects of these early experiences can be long-lasting. Beyond providing a safe care setting, early care environments should provide cognitive stimulation as well. This stimulation need not consist of bringing down a kindergarten curriculum, but rather the provision of age-appropriate learning opportunities. To that end, society needs to recognize the importance of dedicating resources to the early years, before children reach formal schooling and enter kindergarten. Resources are needed to increase the quality of care available (such as through teacher training and education and the provision of age-appropriate materials) as well as to increase the access to the high quality settings for disadvantaged families through subsidies and other economic mechanisms. Learning begins in

infancy, and many poor families must rely on external child care for their infants. The opportunity for enhancing the early development of these children must not be lost.

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