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Article *in* Applied Developmental Science · January 2002

DOI: 10.1207/S1532480XADS0601_05

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Applied Developmental Science
2002, Vol. 6, No. 1, 42–57

Early Childhood Education: Young Adult Outcomes From the Abecedarian Project

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The high-risk infants who initially enrolled in the Abecedarian Project, a longitudinal prospective study of the benefits of early childhood educational intervention within a child care setting, were followed up as young adults (age 21 years). One hundred-eleven infants were in the original sample; 104 took part in the follow up. Treatment was provided in 2 phases: during preschool and in the primary grades. Participants received either both phases, 1, but not both, or neither. Assignment to groups was random. Those in the preschool treatment group earned significantly higher scores on intellectual and academic measures as young adults, attained significantly more years of total education, were more likely to attend a 4-year college, and showed a reduction in teenaged pregnancy compared with preschool controls. Preschool treatment was associated with educationally meaningful effect sizes on reading and math skills that persisted into adulthood. School-age treatment served to maintain preschool benefits for reading, but by itself, the effects were generally weaker than those of the preschool program. Statistically significant differences in the attainment of full economic independence were not found at this stage, but would not be expected among young adults still attending school. The incidence of self-reported violence and lawbreaking was not significantly reduced, although trends in the data favored the treated group. The reported incidence of marijuana use was significantly less among treated individuals. The positive findings with respect to academic skills and increased years of post-secondary education support policies favoring early childhood programs for poor children.

This article reports long-term outcomes of the Abecedarian Project, a longitudinal prospective study of the benefits of intensive early educational intervention for children from low-income, multirisk families. The negative influences of poverty on children's development have been extensively documented (e.g., Brooks-Gunn & Duncan, 1997; Huston, McLoyd, & Garcia-Coll, 1994; McLoyd, 1998; Smith, Brooks-Gunn, & Klebanov, 1997). Childhood poverty is associated with less adequate nutrition (Lewit & Kerrebrock, 1997), lower scores on mental tests (Duncan, Brooks-Gunn, & Klebanov, 1994), 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). Poverty in the United States varies according to ethnic group: African American children are much more likely than White children to experience long-term poverty (Corcoran & Chaudry, 1997; Duncan et al., 1994). Despite recent reports of a drop in poverty

This research was supported by Grant MCJ-370632 from the Bureau of Maternal and Child Health, Grants 95-1796, 97-5994, 98-1752, and 99-8670 from the David and Lucile Packard Foundation, Grant R306F960201 from the Office of Educational Research and Improvement, and Grant 61926 from the Frank Porter Graham Child Development Center.

We thank Margaret Burchinal for consultation on data analysis; Leigh Ann Carr, David Gardner, and Richard Addey for assistance with data collection, entry, and programming; and Marie Butts for administrative support and manuscript preparation. We are particularly grateful to Carrie Davis Bynum, the study's Family Coordinator, for assistance with maintenance of the sample and Katherine Polk for many years' assistance with many phases of the research. Most of all, we are grateful to the young adults and their families for their long-term commitment to the research. Without them, this study would not have been possible.

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rates in all groups, the rate for African Americans remained about three times that for Whites—23.6% compared to 7.7% in 1999 (United States Census Bureau, 2000).

For decades, early childhood programs have been provided to combat poverty's effects on children's development and educational progress. Based on the theory that early experience exerts a strong influence on outcomes in many developmental domains, various home-based and center-based programs have offered training in positive parenting or child-centered intellectual stimulation early in the life span. Most interventionists have used measures of intellectual performance and school progress to evaluate their programs' effectiveness (Gallagher, 1991), and many programs have demonstrated at least short-term benefits (Currie, 1997; Lee, Brooks-Gunn, Schnur, & Liaw, 1990). However, positive effects often eroded shortly after treatment ended (e.g., Currie, 1997; Gallagher, 1991; McKey et al., 1985). The most definitive examination of long-term benefits of early childhood programs to date was conducted by the Consortium for Longitudinal Studies (Lazar, Darlington, Murray, Royce, & Snipper, 1982). Following up participants in 11 scientifically controlled programs, the Consortium 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. Five such studies had follow-up data extending more than 10 years after intervention ended. Findings generally showed that treated individuals, compared to those untreated, were more likely to remain on grade level and subsequently to graduate from high school (Barnett, 1995; Haskins, 1989). Findings with respect to indexes of life success such as delinquency and crime, teen pregnancy, welfare use, and employment were inconsistent (Haskins, 1989).

Although its later start date prevented the Abecedarian Project from being included in the Consortium's follow-up study, it meets that group's standards for scientific rigor. It was a randomized prospective trial in which two major issues were addressed. The first was the malleability of impoverished children's intellectual and cognitive development given early environmental support and enrichment; the second was the degree to which their school performance might be enhanced by preschool and primary school treatment. The Abecedarian Project was theoretically grounded with a conceptual framework based on General Systems Theory (Bertalanffy, 1975; Ramey, MacPhee, & Yeates, 1982). From such a perspective, child development would be viewed as an ongoing process of interactions among hierarchical systems, ranging from that of the individual and factors that directly affect physical survival, to the psychological, involving interactions with caregivers, social systems in homes, schools, and neighborhoods, and societal forces. Early child care provides a vehicle for effecting positive changes in one such ecological system affecting the young child. Although General Systems Theory implies multiple causation for developmental outcomes, it provides a framework showing how changing the early environment, through supporting positive changes in children, could have long-term effects on later accomplishments.

Assignment of children in both of the Abecedarian treatment phases, preschool (5 years from infancy to kindergarten), and school age (3 years in the primary grades), was random. The full design allowed for comparisons among children whose early treatment varied in timing and duration: 8 years (preschool and school-age phases, the experimental–experimental [EE][1] group), 5 years (preschool phase only, the experimental–control [EC] group), 3 years (school-age phase only, the control–experimental [CE] group), and to an untreated control group (no intervention, the control–control [CC] group). The preschool intervention substantially altered the early childhood context in that caregivers were provided a curriculum to enhance the degree to which the early child care environment supported cognitive development and learning (see Ramey & Campbell, 1984). The school-age phase, more family and school mediated, was designed to support early learning in the primary grades through enhanced parent involvement and appropriate individualization within the child's classroom (Ramey & Campbell, 1991).

To conduct a long-term follow-up of the Abecedarian, study was particularly important for two reasons. First, of the earlier programs reporting comparable long-term outcomes—the Perry Preschool Project (Schweinhart, Barnes, & Weikart, 1993), the Early Training Project (Gray, Ramsey, & Klaus, 1982), and a comparison of outcomes in Head Start children whose classrooms had differing levels of structure (Karnes, Shwedel, & Williams, 1983)—none provided preschool treatment as intensive, in terms of its duration (full days) and length (5 years), as that of the Abecedarian study. Second, the two other programs that did provide high-risk children with equally intensive and long-lasting preschool programs—the Syracuse Family Development Research Program (Lally, Mangione, & Honig, 1988) and the Milwaukee Project (Garber, 1988)—have not tracked their graduates into adulthood.

From early childhood through middle adolescence, the cognitive and academic benefits of the Abecedarian Project have been larger and more persistent than those of other early intervention programs. By the age of 18 months and thereafter throughout the preschool period, treated children earned significantly higher scores than

[1]The first letter indicates the treatment condition during the preschool years, experimental or control; the second letter indicates the treatment condition during the primary grades, experimental or control.

controls on intellectual measures (Ramey & Campbell, 1984). Assessments at the end of the school-age treatment phase indicated that both reading and mathematics scores increased as a linear function of the number of treatment years (Ramey & Campbell, 1991). Abecedarian participants were subsequently followed up at intervals comparable to those of the Consortium programs, with reassessments at ages 12 (Campbell & Ramey, 1994) and 15 years (Campbell & Ramey, 1995). Preschool treatment was associated with a significant improvement in academic skills through 7 (age 12) and 10 years in school (age 15). In addition, students with preschool treatment had significantly fewer placements into special education and retentions in grade. Participants with preschool treatment maintained a consistent, modest IQ advantage through age 15; treatment effect sizes on cognitive test scores were largest during the preschool years and diminished somewhat during later childhood and adolescence (Campbell & Ramey, 1994, 1995). Both reading and mathematics scores showed larger effect sizes for preschool treatment than for school-age treatment (Ramey et al., 2000).

The program most directly comparable to the Abecedarian study is the Perry Preschool Project, a scientifically rigorous study with a sufficient sample size and low attrition that allowed its long-term outcomes to be reliably ascertained. With participants tracked through age 27, the Perry Preschool investigators reported significant benefits in the form of higher rates of high school graduation and employment for treated women, and higher paying jobs, fewer arrests, and more home ownership for treated men. These interventionists estimated that every dollar spent on early childhood eventually saved more than $7 through increased adult employment and reductions in crime among treated participants (Schweinhart et al., 1993; Barnett, 1995, 1996), a finding widely cited to justify other early childhood programs.

The Abecedarian study represents a more intensive treatment than that provided in the Perry Preschool. Its treatment began in early infancy, whereas that in the Perry Preschool started with 3- or 4-year-olds; it provided educational intervention in a full-day child care setting rather than in a half-day preschool, and the Abecedarian treatment continued for one half of the children through the first 3 years in public school. The Perry Preschool linked weekly home visits to its preschool classroom experience; the Abecedarian program did not. Although both programs targeted low-income children, and both served predominantly African American children, the participant population in the Perry Preschool was limited to children whose age-3 IQs were between 70 and 85 points. In contrast, the range of intellectual test scores in the Abecedarian Project participants was not constrained.

Despite these differences, the Perry Preschool and Abecedarian programs are sufficiently comparable that the latter affords an opportunity to learn if the benefits of the Perry Preschool could be replicated. Critics have charged that the Perry Preschool results were overgeneralized when used to justify expenditures for different programs such as Head Start (e.g., Hood, 1992). Controversy over the long-term benefits of early childhood intervention continues to generate intense debate, and the Abecedarian study has been cited both in support of such efforts (e.g., Clinton, 1996) and as proof of their futility (e.g., Herrnstein & Murray, 1994).

The theoretical framework for the Abecedarian young adult follow up was influenced both by its own General Systems Theory orientation (Ramey et al., 1982) and by Bronfenbrenner's ecological system (Bronfenbrenner & Morris, 1998). Both approaches emphasize that individual development is influenced at multiple levels ranging from characteristics of the self outward to the family, school, community, and nation. These factors affect the child's reactions to environmental stimuli; at the dyadic level as well as more broadly, children, their caregivers, the features of the environment, the degree of stability of control provided by persons and objects in the child's space, and all affect the construction of reality for the child and the child's development of trust and skill. The question investigated in this study was, given that an enriched early child care environment had enhanced cognitive skills in early childhood, how much might those intellectual and academic gains be linked to positive changes in young adult circumstances? Key domains measured at age 21 were as follows:

1. Intellectual level.
2. Academic skills.
3. Degree of self-sufficiency.
4. Social adjustment as indexed by admissions of negative outcomes (substance abuse, violence, and convictions for crimes).

Method

Preschool and School-Age Phases

Sample. Starting with pilot research in 1971 and enrollment of participants in 1972, the Abecedarian Project provided a prospective, in-depth study of the lives of multirisk families and their children. Local social service agencies and prenatal clinics helped to identify potential participants. Selection criteria were based on 13 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 assigned to preschool treatment or control status on the basis of a table of random numbers. A total of 109 eligible families, to whom 111 infants (1 set of identical twins, 1 sibling pair) were born, accepted their random assignments, and agreed to take part. Fifty-seven infants (28 girls and 29 boys) were assigned to the experimental (E) group, and 54 (31 girls and 23 boys) were assigned to the control (C) group. The characteristics of families in the two groups were very similar. All families met poverty guidelines. The typical mother was young ($M = 20$ years old), had less than a high school education ($M = 10$ years), unmarried, lived in a multigenerational household, and reported no earned income. One third were on public assistance. Ethnicity was not a selection factor, but of those who took part, 98% were African American.

Early Childhood Procedures. The service delivery model was child centered, with treated children having full-day child care year round. A systematic curriculum involving "educational games" emphasizing the development of skills in cognition, language, and adaptive behavior was provided (Sparling & Lewis, 1979, 1984, 2000). The infant games involved simple, age-appropriate, adult–child interactions such as 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, and 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.

Families in both the treated and control groups received supportive social services as needed. Control infants had nutritional supplements for the first 15 months of life. Although control-group children did not receive systematic educational intervention (e.g., Ramey & Campbell, 1984, 1987; Ramey et al., 1976), a number of them attended other child care centers, some entering in infancy, others later in the preschool years (Burchinal, Lee, & Ramey, 1989). Therefore, the treatment and control comparisons were between children who had the Abecedarian educational child care and others reared either at home or in the variety of child care settings utilized by local low-income families.

School-Age Procedures. Based on the 48-month cognitive test score, pairs of children were matched within the preschool treatment and control groups, then randomly assigned to school-age treatment and control groups. This created four treatment conditions: children with preschool plus school-age treatment, designated EE; those with preschool alone, EC; those with school-age treatment alone, CE; and those who were untreated in both phases, CC. Families treated in the school-age phase were assigned a home–school resource teacher (HST) who served as a liaison between the school and the home for the first 3 years the child attended public school. The goal was to increase parental involvement in the children's learning. To focus parental efforts, individualized curriculum packets were devised for each child based on the child's needs as identified by the classroom teacher. These activities were delivered to the home every other week. Parents were encouraged to use them at least 15 min each day with the children. Feedback was sought as to the success of each activity as new ones were delivered. Most parents rated the activities highly and said they used them regularly. Because regular meetings with classroom teachers and parents took place, the HST was able to enhance communication between families and schools. She (only females were hired for these positions) also supported families through counseling or by referrals in situations that compromised the parent's ability to concentrate on the child's school progress (Ramey & Campbell, 1991).

Young Adult Follow-up Study

Current Sample and Attrition

At age 21, 105 of the original 111 infants were living and eligible for follow up. One man and 1 woman in the treated group were deceased and 1 woman proved to be ineligible for inclusion.[2] One woman in the control group was withdrawn from the study and 2 women in that group were deceased. Of the 105 eligible individuals, all were located, and 104 took part (1 declined), giving an overall retention rate of 93.7% of the original infant participants, and 99% of those eligible at this age. Table 1 summarizes, according to the preschool and school-age phases of the study, the number and gender of the individuals eligible for follow up as young adults. Preschool attrition meant that only 96 individuals were given school-age group assignments. The individual who declined to participate in the young adult study was among the 96, reducing the number in the four group comparisons to 95.

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

[2] An idiopathic seizure disorder was diagnosed in infancy rendering the baby ineligible for inclusion. Services including full-time child care, professional consultation, and therapy were provided for the child, but her data were excluded from the respondent pool.

Table 1. *Number and Gender of Participants in the Age-21 Follow up of the Abecedarian Sample*

	Group				
Preschool Two-Group Analyses	**Treatment**		**Control**		**Total**
Female	25		28		53
Male	28		23		51
Total	53		51		104
Four-Group Analyses	**EE**	**EC**	**CE**	**CC**	
Female	14	8	13	12	47
Male	11	15	11	11	48
Total	25	23	24	23	95

Note: EE = treated in both preschool and primary grades; EC = treated in preschool only; CE = treated in primary grades only; CC = not treated.

parents were contacted separately by letter and invited to enroll in this phase of the study. The target assessment date was 1 month on either side of the young adult's 21st birth date. Over two thirds of the sample were assessed during the target time window; the rest, with four exceptions, within 1 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. Individuals were seen at the child development center, typically in a single session. Assessors were advanced graduate students in clinical or school psychology. All were unaware of the participants' early treatment histories. Two of the assessors were African American, one was White. The study's protocol was reviewed and approved by the University's Academic Affairs Institutional Review Board. As an added protection, a Certificate of Confidentiality was obtained from the Federal Government to protect study participants and staff from subpoenas should a participant disclose illegal activities.

Instruments

The major domains measured included intellectual level and academic skills, educational attainment, skilled employment, self-sufficiency, and social adjustment, which included indexes of substance abuse and lawbreaking.

Intellectual level and academic skill. As in all previous phases, standardized instruments were selected that demonstrated high levels of reliability and validity and were in sufficiently wide use to permit comparison of present results with similar studies. Norms for intellectual and academic instruments had to include African Americans in proportion to population representation. Instruments already used at earlier ages to assess cognitive and academic levels were administered where possible to permit the investigators to examine longitudinal trends while reducing error related to using different tests. The standardized instruments included in this round of data collection were the Wechsler Adult Intelligence Scale–Revised (WAIS–R; Wechsler, 1981) for intellectual levels and the Woodcock–Johnson Psychoeducational Battery–Revised (WJ–R; Woodcock & Johnson, 1989) for academic skills in reading and mathematics. Broad Reading scores were based on subtests labeled Letter–Word Identification and Passage Comprehension; Broad Mathematics subtests included Calculation and Applied Problems.

Educational attainment. 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. These interviews were conducted by individuals unaware of the young adult's early childhood involvement in the program. Interviews were audiotaped. Factual data were entered into the computer according to schemes established for each item. The young adult described educational attainment in terms of when and where he or she finished high school or obtained a general equivalency diploma certificate, and all educational attainments post high school: community college, vocational schools, or 4-year colleges or universities attended.

Skilled employment. During the YAI, the respondent was asked to describe current employment in terms of his or her current position and also asked to give a history of previous jobs. The positions were coded according to the Hollingshead Index of Social Class (Hollingshead, undated). Skilled employment is defined as a rating of 4 or higher on this scale.

Self-sufficiency. Also devised locally was a Scale of Independent Living. This scale was comprised of four 5-point Likert-type scales summarizing self-sufficiency in economic support, living arrangements, transportation, and medical care. Project staff reviewed YAI tapes

to score this scale after the YAI was completed. For this scale, interrater reliability of .80 was established for perfect agreement, and .94 for within 1-point agreement between the principal investigator and the project staff.

Social adjustment. Questions covering self-reports of lawbreaking were included in the YAI: The number of convictions for misdemeanors or felonies and amounts of time incarcerated or on probation were included. 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. To assess substance use and abuse, items covering use of alcohol, binge drinking of alcohol (five 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" were examined.

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 ($N = 104$) or school-age group ($N = 95$) random assignment, regardless of the length of exposure. This has the advantage of increased stringency while increasing detection power by increasing the number of individuals available for analysis. Post hoc analyses were then conducted with data from 5 individuals originally assigned to the preschool treatment group removed from the sample. All these individuals left the program before the age of 3 years, 4 of them by age 1. 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.

General Linear Models (GLMs) were used to examine treatment effects for continuous outcome variables. For analysis of preschool effects, 2 (treatment group) × 2 (gender) × (Treatment Group × Gender) models were tested. For categorical variables, chi-square analyses were used. Because of small cell sizes, gender was not included in four-group GLM analyses of treatment effects; rather, 2 (preschool group) × 2 (school-age group) × (Preschool × School-Age Group) models were tested. Because of small cell sizes, only the cognitive and academic data were analyzed using the four-group model.

Results

Cognitive Scores

Preschool effects. Table 2 gives unadjusted means and standard deviations for the Full Scale, Verbal, and Performance IQ scores attained by the young adults at age 21. The preschool groups differed significantly on Full Scale IQ, $F(1, 100) = 5.71, p < .05$; and Verbal IQ, $F(1, 100) = 5.21, p < .05$. The absolute differences in mean Full Scale IQs and Verbal IQs for the treated and control individuals were modest, 4.4 points for Full Scale IQ and 4.2 for Verbal IQ. Main effects for gender were not found, but the Preschool Group × Gender interaction approached significance for the Verbal IQ score, $F(1, 100) = 3.28, p < .10$. Treated women scored about eight points higher than untreated women,

Table 2. *Effects of Preschool Intervention and Gender on Cognitive and Academic Functioning*

	Preschool Group						
	Treatment		Control		*F* Value[a]		
	M	*SD*	*M*	*SD*	Treatment	Gender	Treatment Gender*
IQ							
Full Scale	89.7	10.1	85.2	8.6	5.71*	0.08	2.40
Verbal	88.4	10.2	84.2	8.3	5.21*	0.00	3.28**
Performance	93.4	11.5	89.9	11.2	2.37	0.00	1.25
Woodcock–Johnson							
Broad Reading	93.3	16.8	87.6	13.2	3.78**	0.33	2.51
Letter–Word Identification	97.2	20.5	89.1	14.5	5.43*	0.79	1.98
Passage Comprehension	91.0	12.0	88.7	12.5	0.87	0.00	2.52
Broad Mathematics	89.2	11.5	84.4	11.2	4.13*	0.35	2.11
Calculation	92.6	14.1	85.9	13.3	5.92*	0.11	2.55
Applied Problems	87.3	9.2	84.7	9.3	1.76	0.86	1.54
Reading-Grade Equivalent	11.1	4.2	9.3	3.1	6.48*	0.85	1.91
Math-Grade Equivalent	9.2	3.3	7.9	3.0	4.12*	0.24	3.03**

Note: Treatment group $n = 53$; control group $n = 51$.
[a] $df = 1,100$, for all F tests.
*$p < .10$. **$p < .05$.

whereas scores for men were even across treatment and control conditions (for treated women, $M = 90.2$, $SD = 11.8$; for control-group women, $M = 82.8$, $SD = 8.1$; for men in the treatment group, $M = 86.9$, $SD = 8.5$, for control-group men, $M = 86.0$, $SD = 8.3$).

The mean age-21 Full Scale IQ for the five individuals minimally treated during the preschool years was higher than that of the group as a whole ($M = 99.4$, $SD = 11.8$). With their Full Scale IQ data removed, the mean was 88.7 ($SD = 9.65$) for the remainder of the treatment group. Recalculating the GLM with maternal IQ covaried, the preschool treatment and control groups differed significantly in age-21 Full Scale IQ, $F(1, 92) = 5.93$, $p < .05$. Therefore, the finding of a preschool effect on age-21 cognitive test scores was essentially the same with and without the five individuals who did not receive the full preschool treatment included in the analysis.

Four-group differences. Table 3 contains the unadjusted means and standard deviations for WAIS–R Full Scale, Verbal, and Performance IQ scores, arrayed by the four treatment groups. Results from the four-group model showed a trend toward a preschool effect for Full Scale IQ, $F(1, 91) = 3.05$, $p < .10$, but no effect for school-age treatment. No trends toward group effects on Verbal IQ or Performance IQ, and no Preschool × School-Age interactions were found.

Academic Scores

Preschool effects. Table 2 also contains unadjusted means and standard deviations for WJ–R age-referenced standardized reading and mathematics scores arrayed by preschool group. As young adults, individuals with preschool treatment earned significantly higher scores on Broad Mathematics, $F(1, 100) = 4.13$, $p < .05$. Examining the components of the Broad Mathematics score indicated that the preschool advantage was significant for Calculation, $F(1, 100) = 5.92$, $p < .05$, but not for Applied Problems. For Broad Reading, the preschool effect approached significance, $F(1, 100) = 3.78$, $p = .055$. Disaggregating this score showed that the treatment and control groups differed significantly on Letter–Word Identification, $F(1, 100) = 5.43$, $p < .05$, but not on Passage Comprehension. No significant main effects for gender or Group × Gender interaction was found for either subject. Recalculating the models with data from the five minimally treated individuals removed and maternal IQ covaried produced similar results for Broad Reading, $F(1, 92) = 3.89$, $p = .052$; and for Broad Mathematics, $F(1, 92) = 4.11$, $p < .05$.

Also shown in Table 2 are grade equivalent scores for WJ–R Broad Reading and Broad Mathematics earned at age 21. By this metric, both subjects showed significant preschool treatment effects, $F(1, 100) = 6.48$, $p < .05$ for reading; and $F(1, 100) = 4.12$, $p < .05$ for math. Those with preschool treatment earned grade equivalent scores almost 2 years higher than those of preschool controls. 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 preschool cases indicated a significant difference for the reading grade equivalent, $F(1, 92) = 7.15$, $p < .01$; and a trend toward a preschool effect for the math grade equivalent, $F(1, 92 = 3.80$, $p < .10$.

Four-group differences. Neither of the aggregate WJ–R scores, Broad Reading or Broad Mathematics, showed significant preschool effects, school-age effects, or Preschool × School-Age treatment effects when the four-group models were tested, but there were trends toward preschool effects on Letter–Word Identification, $F(1, 91) = 2.88$, $p < .10$; and Calculation, $F(1,91) = 3.58$, $p < .10$. Figures 1 and 2 depict effect sizes (Cohen, 1988) for the Reading and Math scores of the three treatment groups contrasted with the scores of the untreated controls (CC) at four ages: 8, 12, 15, and 21 years. Effect sizes were calculated by subtracting the mean of the CC group from that of each of the other groups and dividing the remainder in each instance by the standard deviation of the CC group. According to Cohen (1988), an effect size of .20 is considered small, but may be meaningful; an effect size of .50 is medium; and an effect size of .80 is large (p. 40). By this measure, the Abecedarian treatment influenced reading achievement more strongly than mathematics achievement. Through age 21, large to medium effect sizes for the full 8 years of treatment were found for reading (ranging from 1.04 at age 8 to .79 at age 21). The effect size for preschool treatment alone varied from .75 at age 8 to .28 at age 21. In contrast, effect sizes for school-age treatment alone (CE group) ranged from .28 at age 8 to .11 at 21, all in the small range or less. For mathematics, effect sizes for the full 8 years of treatment ranged from .64 to .42, whereas those for preschool treatment alone ranged from .27 at age 8 to .73 at age 21. Effect sizes for school-age treatment alone ranged from .11 at age 8 to .26 at age 21.

Life-Success

Table 4 summarizes selected young adult demographic outcomes as a function of preschool treatment and control-group status.

Educational attainments. Individuals treated in preschool completed significantly more years of education by age 21 than did preschool controls, $F(1, 99) = 5.00$ $p < .05$. For individuals with preschool treatment, $M = 12.2$ years of education, $SD = 1.5$ years. For the preschool control group, $M = 11.6$ years, $SD = 1.4$ years. Although there was not a significant main effect

Table 3. *Effects of Preschool and School-Age Intervention on Cognitive and Academic Functioning*

	EE		EC		CE		CC		*F* Values[a]		
	M	SD	*M*	*SD*	*M*	*SD*	*M*	*SD*	Preschool	School Age	Preschool* School Age[a]
IQ											
Full Scale	89.3	10.0	88.0	9.0	84.9	10.2	85.7	7.4	3.05*	0.02	0.31
Verbal	87.7	8.9	86.5	9.1	85.1	10.2	83.6	6.6	2.33	0.57	0.01
Performance	93.4	12.6	92.8	11.4	87.4	11.6	92.2	10.3	1.94	0.08	1.33
Woodcock–Johnson											
Broad Reading	93.7	13.4	89.3	18.9	87.8	17.2	86.8	8.9	1.88	0.78	0.31
Letter–Word Identification	97.6	17.7	92.6	22.7	88.7	17.5	89.0	12.0	2.88*	0.39	0.53
Passage Comprehension	90.9	9.3	88.4	13.2	89.2	15.2	87.0	7.5	0.40	0.95	0.00
Broad Mathematics	86.5	7.4	88.9	12.1	85.3	14.5	83.3	7.6	2.32	0.01	0.97
Calculation	90.2	9.2	92.3	16.3	87.4	16.3	84.6	10.8	3.58*	0.02	0.79
Applied Problems	84.5	6.5	87.3	8.0	85.0	12.5	83.9	5.3	0.69	0.21	1.28
Reading-Grade Equivalent	11.1	3.9	10.3	4.4	9.6	3.7	8.9	2.7	3.60*	0.93	0.02
Math-Grade Equivalent	8.3	2.3	9.4	3.4	8.4	3.9	7.4	2.0	2.18	0.00	2.92*

Note: EE = treated in preschool and primary grades, $n = 25$; EC = treated in preschcol only, $n = 23$; CE = treated in primary grades only, $n = 24$; CC = not treated, $n = 23$.

[a] $df = 1,91$, for this analysis.

*$p < .10$.

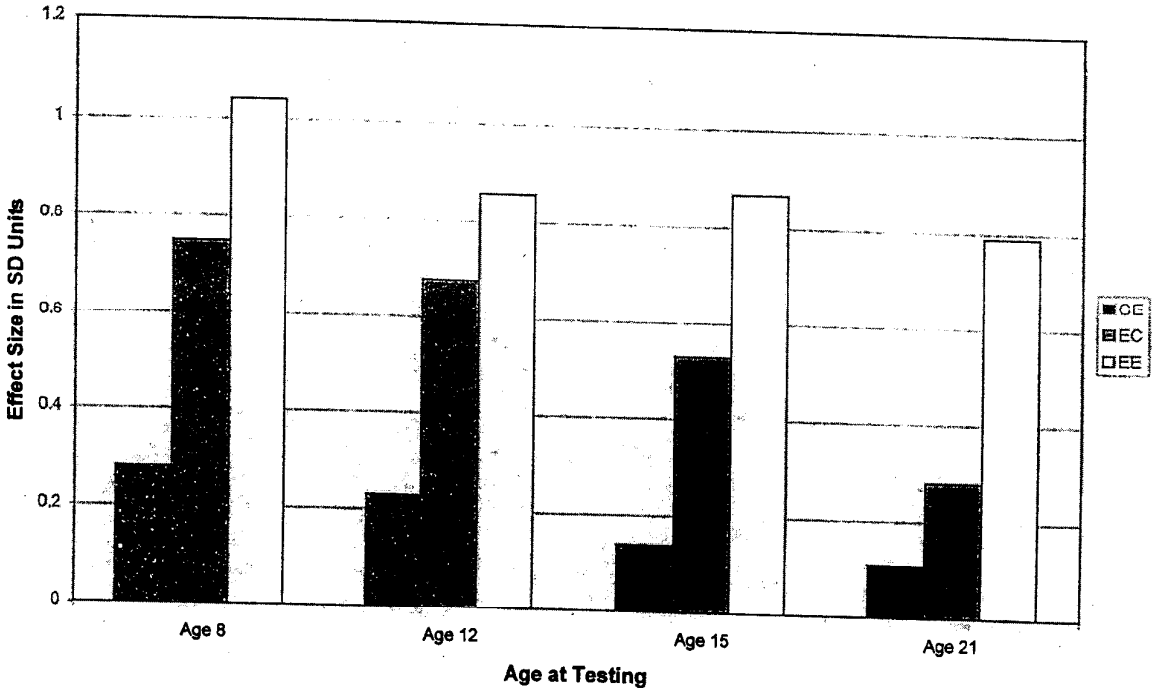

Figure 1. Longitudinal effect sizes for reading by treatment group.

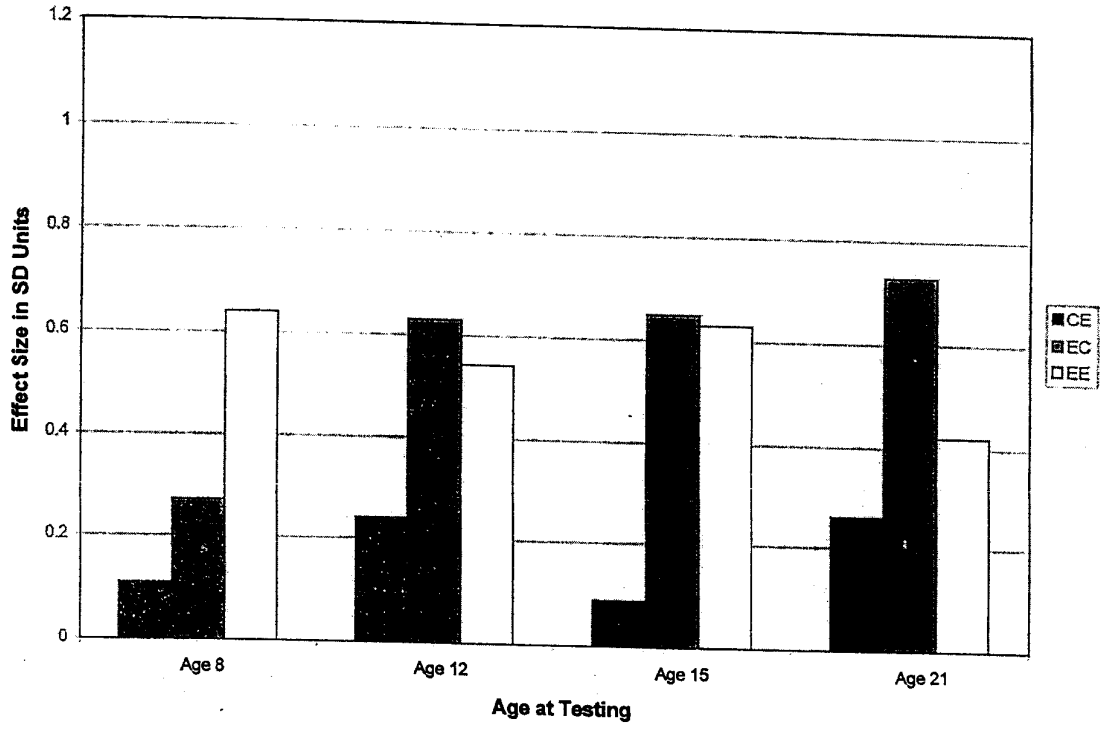

Figure 2. Longitudinal effect sizes for mathematics by treatment group.

Table 4. *Demographic Characteristics of Abecedarian Young Adults at Age 21 Years, by Preschool Group*

	Preschool Treated[a]	Preschool Control[b]	χ^2 (1*df*)
% High School Graduates	70	67	0.12
% Enrolled in 4-Year College or University	36	14	6.78**
% Currently Employed	64	50	2.10
% Held Job Hollingshead 4 or Higher	67	41	6.72**
% Married	4	10[f]	0.80
% Number of Children			
0	60	51	0.93
1	30	27	
2	9	18	
3	0	4	
% Teenaged Parent (< 20 Years)	26	45	3.96*
% Report Misdemeanor Conviction[c]	14	18	0.30
% Report Felony Conviction[c]	8	12	0.44
% Report Incarceration[c]	14	21	1.17
% Used Marijuana in Past Month[d]	18	39	5.83*
% Used Cocaine or Other Drugs Ever[d]	10	6	0.54
% Regular Smoker[d]	39	55	2.52***
% Drank Any Alcohol in Past 30 Days[d]	76	72	0.20
% Binge drinking[e] in Past Month[d]	37	27	1.12

[a]N = 53. [b]N = 51. [c]Two treated individuals declined questions on law breaking, thus for these items, $n = 51$. [d]Two treated individuals declined the Risk Taking Survey, thus for drug use items. $n = 51$. [e]Binge is defined as five or more drinks in a row. [f]One individual in this group had been married but was separated.

*$p < .05$. **$p < .01$. ***$p < .20$.

for gender, the interaction of Treatment × Gender was significant, $F(1, 99) = 4.19, p < .05$. Women with preschool treatment earned 1.2 more years of education ($M = 12.6$ years, $SD = 1.6$ years) than women without ($M = 11.3$ years, $SD = 1.4$ years). Men, 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 preschool treatment were also significantly more likely to be in school at age 21. A significantly higher percentage of those with preschool treatment were currently in school (42%) than was true for preschool controls (20%), $\chi^2(1, N = 104) = 5.85, p < .05$. Moreover, 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, $\chi^2(1, N = 104) = 6.78, p < .01$.

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

Self-sufficiency. The treated and control groups did not differ significantly in the degree to which they had attained economic self-sufficiency, here defined by four indexes of independent living: not requiring financial support from others, maintaining a home of their own, having their own means of transportation, and having medical coverage. Descriptively, fewer young adults who experienced the early childhood program were living in homes of their own at age 21 (19% compared to 29% of preschool controls). Few at this age were rated as maintaining full support for themselves and any dependents (9% of the preschool treatment group compared with 6% of controls). Those with preschool treatment were slightly more likely to have medical coverage than those in the preschool control group (45% compared with 31%). About one half of each preschool group had cars of their own by age 21.

Parenthood. Numbers of children born to young adults in the study sample (ranging from 0–3) are summarized in Table 4. Most of these births were to unmarried individuals—of the study sample, only seven had married when interviewed (five women, two men). One of the men was by then separated. Four of the seven were among the 46 individuals who had one or more children. Within this sample, women tended to have more children than men, $F(1, 103) = 3.09, p < .10$. In all, 40 children had been born to women compared with 24 reported by men. There was not a significant effect for preschool or a significant Gender × Preschool interaction for the number of children born. Descriptively, however, women in the treatment group had delayed having children to some extent: 56% of them reported none by age 21, compared with 43% of

control women. It is also noteworthy that fewer second or third births were reported by treated women. Of the 44% of treated women ($n = 11$) who had a child, only 3 had a second child, none had a third. In contrast, 57% ($n = 16$) of women in the preschool control group had a child by age 21; 6 had two children and 2 had a third. In other words, almost twice as many children were born to women in the preschool control group (26 in all) as to women with preschool treatment (14 children in all). The percentage of treatment and control-group men with children was similar: 36% of treated men compared with 39% of control-group men reported having children at age 21. Twelve children in all were born to 10 treated men and 12 were born to 9 control men.

Among those who did have children by age 21, preschool treatment was associated with a significant delay in the average age at first birth. The mean age at the birth of a first child was 19.1 years, ($SD = 2.1$ years) for the preschool treatment group compared with 17.7 years ($SD = 1.5$ years) for preschool controls, $F(1, 41) = 5.26, p < .05$. However, the youngest parent in both groups was 15 years old when she or he reported having a child. Defining a teen parent as one aged 19 or younger when a first child was born, preschool treatment was associated with a significant reduction in teen parenthood (26% of those treated compared with 45% of controls had children as teens), $\chi^2(1, N = 104) = 3.96, p < .05$.

Social adjustment. Indexes of social adjustment included self-reported use of legal and illegal substances, substance abuse, violence, and crime. Marijuana use within the past 30 days was significantly less among the treated individuals. Eighteen percent cited some level of usage during that period, compared to 39% of controls, $\chi^2(1, N = 102) = 5.83, p < .05$. Early treatment had no significant impact on reported use of other illegal drugs. Most persons denied using any; cocaine use, for example, was denied by 99 of the 102 individuals who completed the risk survey. Alcohol use was common and comparable among those with and without preschool treatment. Seventy-three percent of the controls and 76% of the treated individuals indicated that they had one or more drinks within the past 30 days. Alcohol abuse, here defined as binge drinking (five or more drinks in a row within the past 30 days), was admitted by approximately one third of the participants, 37% of those responding in the treated group, and 27% of the control group; this difference was not significant. There was a tendency toward a reduction in smoking for those with preschool treatment—39% of the treated group and 55% of the controls described themselves as regular smokers, $\chi^2(1, N = 102) = 2.52, p = .11$. (Two individuals in the treated group did not complete the Risk Behavior Survey, from which the substance use statistics were taken.)

The percentages of treated and control participants who admitted to carrying a weapon or violent behavior during the past month were virtually identical: 33% of the control participants and 35% of those treated in preschool responded "yes" to any instance of either kind of behavior. Table 4 gives the percentages of individuals in both groups who, in responding to the YAI, reported convictions for misdemeanors and felonies. Only one treatment group woman reported a misdemeanor conviction compared to four in the control group. No woman in either group reported a felony conviction. For men, the number reporting misdemeanor convictions was the same for both groups ($n = 5$), whereas six control-group men and four treated-group men reported felony convictions. These differences are not statistically significant.

Discussion

This study reported the young adult follow up of the Abecedarian Project, one of the most intensive early childhood intervention programs ever provided for children from low-income families. Because the study sample was 98% African American, the findings generalize to that segment of the population, and the group comparisons made here reflect differences among African Americans, born into low-income families, who either did or did not experience the Abecedarian early childhood program. The outcomes show that high-quality educational child care can make a dramatic difference in the lives of young African American adults reared in poverty. Individuals assigned to the preschool treatment group had, on average, significantly higher cognitive test scores as young adults than did untreated controls, they earned higher scores on tests of reading and mathematics skills, they attained more years of education, they were more likely to attend a 4-year college or university, and they were less likely to become teen parents.

Confidence in these findings is increased by the randomized design of the study, which reduced the likelihood that selection bias accounted for the long-term differences. In addition, attrition has been low. During the early childhood years, the investigators tried to control for some factors that might have contributed to differences in outcomes. For example, the quality of the nutrition at the child care center might have enhanced early brain growth among treated infants. Therefore, control-group infants were supplied iron-fortified formula during the first year to reduce the likelihood that any cognitive differences seen were due to better diets in treated infants. Supportive social work services and crisis intervention were provided for families in both groups. In cases where routine cognitive assessments revealed developmental lags in control children, the family was referred to a relevant agency

for follow up. This policy resulted in four control children being moved to the head of waiting lists for scarce slots in other quality community child care centers. In addition, several control families voluntarily enrolled their children in such centers. For these reasons, it is likely that the group comparisons made here are conservative estimates of the possible benefits of educational childcare for poor children, and confidence is increased that current long-term group differences resulted from the systematic educational program provided to the Abecedarian treatment group.

A concern throughout the life of the Abecedarian study has been the relatively small number of study participants given the number of measures collected over the years. Confidence that significant findings are not simply due to chance is greatly increased by the longitudinal nature of the study. These findings are consistent with those obtained earlier with the same sample (e.g., Campbell & Ramey, 1994, 1995; Ramey & Campbell, 1984, 1991). Moreover, they are consistent with the theory being tested; that is, that enhancing the stimulus value of the early environment could, in turn, enhance cognitive development and ultimately, school success.

That a significant cognitive test score advantage related to preschool treatment would be found in young adulthood was not expected because many previous early childhood programs found little IQ difference in treated and control individuals after 3 or 4 years in public school (Lazar et al., 1982). One important difference between the Abecedarian program and most others was that the educational intervention began in infancy. However, whether the persistence into adulthood of treatment effects on intellectual measures was related to starting in infancy cannot be determined from these data because the study model confounds duration and timing. The earlier phase of treatment covered 5 years, from infancy to kindergarten entry, whereas the school-age phase lasted only 3 years. The Abecedarian treatment was also more intensive than most other early childhood programs in that it was provided for full days, 5 days per week, year round. This level of intensity was possible because the early childhood intervention program was embedded in full-time child care. In contrast, many of the preschool programs followed up by the Consortium (Lazar et al., 1982) were half-day programs provided during only part of the year. Most began after the infancy period as well. These variations among programs leaves open the question of whether starting in infancy or more intensive treatment led to greater persistence of treatment effects in the Abecedarian study compared with other early childhood programs.

The 21-year span of this study provides valuable information about the course of cognitive development with and without early intervention. A manuscript examining the longitudinal development of cognitive and academic skills among the Abecedarian sample is currently in press, showing that rates of change in cognitive functioning were most rapid during the early years and that treatment effects were more pronounced in that phase. An associated advantage in academic performance persisted from school entry to adulthood. In addition, early childhood cognitive test scores were found to mediate the effects of preschool on later academic outcomes (Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, in press). This finding supports an earlier analysis predicting academic outcomes through age 15 in which the enhancement of early childhood treatment led to better intellectual test performance that, in turn, predicted early school performance, and that, in turn, best predicted mid-adolescent school performance (Campbell, Helms, Sparling, & Ramey, 1998). It also supported the findings from a comparative study of causal models using data from the Perry Preschool study that confirmed a "cognitive effects" model in preference to a socialization model or parent involvement model to explain program effects (Barnett, Young, & Schweinhart, 1998).

Higher standardized scores in reading than in mathematics were earned by young adults across all groups. Effect sizes for both reading and mathematics were in the moderate range (.40 and .38 for preschool treatment effect on reading and mathematics, respectively). Within the WJ–R Broad Reading and Broad Mathematics scores, treatment had stronger effects on Letter–Word Identification and Calculation than on Reading Comprehension and Applied Mathematics. The reason for this is not immediately apparent. To succeed at Letter–Word Identification, the examinee is required only to pronounce words correctly. However, the words were chosen such that, at the higher levels, unfamiliar words would probably be mispronounced by most test takers, making this task somewhat analogous to a vocabulary test. In contrast, Passage Comprehension requires that the meaning of selected passages be grasped sufficiently that a single apt missing word can be supplied. Similarly, Applied Problems requires understanding and applying mathematical principles. There are hints here that preschool education was less effective in long-term enhancement of higher order inductive reasoning skills, or perhaps that public schools need to do more to expand the thinking of students in these ways. The data from both the Abecedarian and Perry Preschool studies imply that schools were somewhat more successful in teaching reading than mathematics. Garber (1988) noted, with respect to how participants in the Milwaukee study were faring in elementary schools, that schools "were comparatively more successful in promoting reading than mathematics skills over the 4-year period (that he tracked his study participants)" (p. 265).

The small size of the Abecedarian sample means that, when the four-group models were tested, power

was reduced to the point that it was marginal for reading and poor for math. The obtained difference in group means for reading would need to have been 15% larger than that obtained to give us .77 power to detect it. For mathematics, it needed to be over 50% greater to be detected at .80. Given marginal to poor power to detect differences, the probability that we made a Type 2 error in rejecting the hypothesis of a long-term school-age treatment effect on academic test scores appeared to be low. We can only speculate about why school-age treatment appeared to have weaker effects than preschool treatment. Rather than focusing directly on the children, treatment during the primary school years was parent mediated, meaning that control over program delivery was necessarily less in this phase. Feedback from parents indicated a range of compliance in using the home activities. Whatever contributed to the difference in the impact of the preschool and school-age treatments, the implication seems clear. Encouraging parents to work with children at home during the primary grades did not have as powerful an effect on long-term academic indicators as did preschool education.

These academic findings must be interpreted within the ecological context of the study. The local community was a small Southeastern university town with an excellent school system where the majority of students were from academically oriented families. Competition within the school system was high, and students whose performance would have been average relative to national norms were somewhat behind the local norm. The study's participants represented both an economically disadvantaged group and an ethnic minority. The school system was strongly committed to closing the achievement gap between the majority and minority students, but students themselves were nonetheless aware of it. An ethnographic study conducted with a subgroup of the Abecedarian young adults revealed the belief among some that their more advantaged school peers denigrated their ability. Of these, some took this as a challenge. For others, it led to alienation. A second concern was the feeling that racism influenced their treatment by some majority group teachers (Peart & Campbell, 1999).

The gap in cognitive test scores for individuals treated and untreated in preschool was greater for women than for men. Similarly, treated women made greater educational progress relative to untreated women than was true for treated men relative to untreated men. Differential benefit for women is consistent with research from other early childhood programs. Gray, Ramsey, & Klaus, (1983) found that women treated in the Early Training Project were more likely to graduate from high school than were treated men, although the Treatment × Gender interaction was not statistically significant. Similarly, Schweinhart et al. (1993) found that women treated in the Perry Preschool study, rather than men similarly treated, had significantly higher rates of high school graduation. More recently, a survey of young adults who had attended Head Start showed a long-term benefit for women, not men (Mathews, 2000). The Abecedarian finding of stronger effects on educational outcomes among women is consistent with the literature indicating that African American men are especially vulnerable to poor school performance (e.g., Osborne, 1997). In future analyses, other personal factors that may have moderated or mediated the effects of preschool treatment on young adult outcomes, such as academic self-concept or locus of control, will be examined.

Many of the Abecedarian young adults had not attained full economic self-sufficiency by age 21. However, this would not be expected among individuals this age if they were continuing their education beyond high school. The Abecedarian participants who attended a 4-year college were, for the most part, still in school when interviewed at age 21; and, in fact, full economic independence so early in adulthood might have negative implications for the future among this sample. It will require yet further study of the sample to learn how the study participants fare in the world of work. Education in 4-year colleges or universities is associated with stronger earning potential than that in community colleges or vocational schools (Ceci & Williams, 1997). The differential rate of college attendance seen here holds promise of more successful and productive lives in the future, but more research is needed to learn the extent to which this occurs.

Although teen pregnancy was not altogether prevented in the treated group, its incidence was significantly reduced. This is consistent with reports from the Perry Preschool study that fewer out-of-wedlock births occurred in treated women (Schweinhart et al., 1993). This reduction in early childbearing among the treated women could be related to their better educational progress in that plans to continue one's education could deter childbearing, and conversely, delayed childbearing would permit pursuit of education (Furstenberg, Brooks-Gunn, & Morgan, 1987).

Some expected treatment benefits were not found. The reduction in lawbreaking among the Perry Preschool Project's treatment group (Berrueta-Clement, Schweinhart, Barnett, Epstein, & Weikart, 1984) was not replicated in the Abecedarian study, nor were there consistent reductions in self-reports of violence. The failure to replicate the Perry Preschool's reduction in crime and delinquency was disappointing, especially in light of the stronger intellectual and academic benefits found in the Abecedarian study. Comparing rates of lawbreaking across these two studies is problematic in that they were conducted in different locations and in somewhat different time periods. In any event, no significant reduction in self-reported convictions for lawbreaking was found among the Abecedarian young

adults. This finding is consistent with an earlier finding from official state records of charges filed in which 44.9% of individuals in the treated group had records of one or more charges, compared with 41.2% of the controls (Clarke & Campbell, 1998). Reductions in admissions of marijuana use and a trend toward reduced smoking among those with preschool treatment were hopeful indicators of possible reductions in future health problems.

Finally, the question of treatment effects on the parents of these young adults exists. Previous analyses showed that, when their children were 54 months old, teen mothers of treated children (approximately one third of the sample in both preschool groups) made more progress in their own lives compared to teen mothers of control children (Campbell, Breitmayer, & Ramey, 1986). At the time of the age-15 follow up, younger mothers of children in the child care program had themselves obtained more years of education and were more likely to be employed (Ramey et al., 2000). Preliminary analyses of the parent interview data from the young adult follow up indicate that these advantages in educational progress and employment have continued among the relatively younger mothers (Pungello, Campbell, & Miller-Johnson, 2000). These findings are being further analyzed at this time.

The positive findings from this study have important policy implications. They show that a high quality child care program can have a lasting impact on the academic performance of children from poverty backgrounds. Although the Census Bureau reported a trend for the poverty rate to decrease in 1999, African Americans children continue to be at elevated risk for being poor and of remaining poor over greater periods of time (Huston et al., 1994; Ogbu, 1987, 1990; Slaughter-Defoe, Nakagawa, Takanishi, & Johnson, 1990). One study of urban school children found that African Americans fell behind other groups in academic performance within the first 2 years of school (Alexander & Entwisle, 1988). Early academic failure may compound itself, leading to discouragement and alienation (Laffey, 1982; Zigler, Abelson, Trickett, & Seitz, 1982). Educators must not ignore the early years. The need for out-of-home care increases every year, especially as welfare reform now means that mothers not working or in school will become ineligible for help. It is imperative that society should recognize the importance of utilizing child care settings as ready-made sources for early childhood education. Cognitive development is depressed by persistent poverty (e.g., Smith et al., 1997), but the Abecedarian long-term findings indicate that early education can make a positive difference. It is important that child care providers be viewed as teachers for children at risk and trained to professional standards such that the preschool years can be times for positive cognitive development. Men may be especially vulnerable, even in the presence of early intervention, and more research needs to be directed toward ways to support the development of young males. Although not arguing that parents should be displaced as their children's most important teachers in the early years, or that infants and toddlers should be pushed in ways that are developmentally inappropriate, it is nevertheless clear that learning does begin at the beginning of life. We must not waste these years because we cannot afford to waste the potential of any child.

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Received April 13, 2000
Final revision received November 21, 2000
Accepted February 6, 2001

Applied Developmental Science
2002, Vol. 6, No. 1, 58

EDITORIAL STATEMENT

With Gratitude to Professor Richard A. Weinberg

With this issue of *Applied Developmental Science*, the editorial leadership of the journal changes. Richard A. Weinberg, the Emma M. Birkmaier Professor of Educational Leadership in the Institute of Child Development at the University of Minnesota, and a founding editor of *Applied Developmental Science*, rotates off of the editorial team. He has decided to devote his seemingly limitless scholarly energies and inestimable wisdom to other scholarly pursuits. With Rich as our constant collaborator, we have worked together to launch *Applied Developmental Science* and, we believe, to establish it as a premier journal integrating exemplary theory and research pertinent to human development with the visions, values, and strengths of children, families, and communities.

Rich's vision for the application of developmental science involves a seamless integration of scholarly contributions to science and to society. His unimpeachable sense of quality, his vast scholarly knowledge, and his unflagging commitment to social justice made, and continues to make, Rich an exemplary colleague and a sage steward of the efforts of our scholarly community to advance research and application in the service of enhancing the life chances of all individuals and institutions of civil society. We will miss his collaboration on *Applied Developmental Science* and the diverse contributions he made not only to advancing the journal's contributions, but also to our own efforts as editors.

Of course, we are pleased that Rich will continue to be an active colleague within our scholarly community. We know he will continue to make singular and significant contributions to science and society through this work and we wish him all the great successes that we know will be his.

Richard M. Lerner
Editor

Celia B. Fisher
Editor