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ScienceDirect
Economics of Education Review 26 (2007) 113–125
Economics of Education Review
www.elsevier.com/locate/econedurev

Comparative benefit–cost analysis of the Abecedarian program and its policy implications

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Received 1 March 2005; accepted 26 October 2005

Abstract

Child care and education are to some extent joint products of preschool programs, but public policy and research frequently approach these two goals independently. We present a benefit–cost analysis of a preschool program that provided intensive education during full-day child care. Data were obtained from a randomized trial with longitudinal follow-up through age 21. Study participants were 104 economically disadvantaged children and their families. Economic benefits include increased maternal earnings, decreased K-12 schooling costs, increased lifetime earnings and decreased costs related to smoking. Net present value is positive over a range of reasonable discount rates. Program benefits are compared to estimates from other studies with particular attention to a benefit–cost analysis of a half-day preschool program that did not provide child care. Returns to early childhood policy could be improved by greater attention to how programs might maximize education and child care benefits together regardless of the primary aim of the policy's agency sponsor.

JEL classification: I28; j13; j24

Keywords: Education economics; Human capital; Rate of return

1. Introduction

It is increasingly accepted that preschool education can be a sound public investment, especially for children disadvantaged by poverty or other adverse circumstances (Heckman & Krueger, 2004). Barnett (2004) has proposed that returns to preschool programs depend on: (1) precisely what the program provides; (2) who attends the program; and (3) the broader educational, social and economic context of the program. These three factors likely explain much of the difference in outcomes between the now widespread public preschool programs and the intensively studied models on which public programs are at least theoretically based (Barnett, 1998). A better understanding of these factors would make it possible to design more economically efficient preschool policies and programs.

In this paper we seek such insights from a benefit–cost analysis of the Abecedarian program and comparisons to that performed for the High/Scope Perry Preschool program. Our research on

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doi:10.1016/j.econedurev.2005.10.007

the Abecedarian program offers a unique opportunity to examine the economic benefits of full day, year-round child care. Such programs have been subject to far fewer rigorous studies than part-day preschool programs. The Abecedarian program is the only randomized trial of child care with a longitudinal follow-up to adulthood. Yet, much can be learned about how to maximize the public returns to investments in preschool from the study of such programs.

Here, comparisons of costs and benefits will be limited to the Abecedarian and Perry Preschool programs. These two studies represent the entire stock of comprehensive benefit–cost analyses of preschool programs in which the underlying data come from randomized trials. This situation is less limiting than it might appear as these two programs are archetypes of major policy alternatives and to some extent represent a critical divide in U.S. public policy. The Perry Preschool program offered educational experiences of 2.5 h per day for children at ages 3 and 4 during the academic year (approximately 180 days) accompanied by home visits in which teachers provided tutoring and worked with parents. The Abecedarian program offered educational experiences of up to 10 h/day for children from early in the first year of life until they entered kindergarten (approximately 250 days per year).

2. Current policy context

Most U.S. children under 6 yr of age receive some form of non-parental child care or education (Capizzano, Adams, & Sonenstein, 2000). This is a remarkable change over the past 40 yr and reflects increased demand for these services. Between 1960 and 1995, the labor force participation rate of mothers of preschool children increased from 20% to 62% (Committee on Ways and Means, 1998). This trend has encompassed all preschool children.[1] Government's role in subsidizing care and education for preschool children has substantially increased over the years in pursuit of two primary objectives: (1) increasing the labor force participation of women, in particular those who might otherwise require public assistance and (2) improving the learning and development of children at elevated risk of poor educational outcomes associated with poverty. Most of the public funding originates with the Federal government.[2]

Despite the obvious overlap in target populations, child care and early education policies have focused on different primary goals: facilitating parents' employment and improving child development. Child care regulations emphasize health and safety, but do not require programs to conform with preschool education programs (only 4% of funds are to be used to enhance child care quality). There are no federal regulations regarding the educational capacity, goals, or accomplishments of child care. State child care regulations are minimal and, in any case, child care vouchers can be given to unlicensed and unregulated providers. In contrast, Head Start, and similar state preschool programs for disadvantaged children, have program standards relating to education. Although highly variable, these standards require more educated teachers and smaller classes than for child care and they articulate what children are expected to learn and to some extent how they are to be taught (Barnett, Robin, Hustedt, & Schulman, 2004). Generally, these programs serve few children below age 3, operate only 2–3 h/day and follow a school calendar.

Recent years have seen some signs of policy convergence. Head Start has moved to increase the length of its day and launched a small Early Head Start program for children under age 3. Increasingly, Head Start programs operate for 6-h days and provide wrap-around child care. Similarly, some state-funded programs operate for a school day and integrate with full-day child care. Nevertheless, these efforts to bridge the gap between child care and compensatory early education policies remain the exception.

Why should policy makers and others be concerned about these diverging streams of public programs for young children? Each type of program forgoes potential benefits from enhancing children's

[1] Its extent varies by age, with 75% of children between the ages of 3 and kindergarten (usually age 5) in non-parental care and just over 50% of those under age 3 in non-parental care (FIFCFS, 2003).

[2] Federal expenditures on child care and early education programs have risen fivefold since 1973 (see Barnett & Masse, 2003). The largest federal child care program is the Child Care Development Fund (CCDF), a block grant to the states that primarily supports vouchers that parents use to purchase child care. Federal funding for CCDF was $4.7 billion in FY 2004. On top of this, states redirected more than $3 billion to CCDF from the federal Temporary Assistance to Needy Families (TANF) program. The largest federal child development program is Head Start, funded at $6.8 billion in FY 2004.

learning and development in the one case and supporting maternal employment in the other, and these added benefits could well exceed the added costs of altering programs to meet both goals. Witte and Trowbridge (in press) argue that combining these programs and their funding streams could reduce administrative costs, reduce transactions costs for parents and improve educational quality by increasing the stability of program participation. However, the costs of producing good education and full-time child care together are higher than the costs of custodial child care or part-day preschool programs, particularly if this goes beyond merely adding wrap-around care to existing preschool education. Education is much more expensive per hour because of the higher costs of qualified teachers and smaller class sizes. Full time child care requires up to 2500 h/yr for 5 years, compared to 360–1080 h/yr for 1 or 2 years of preschool education beginning at age 3 or 4. The benefits would have to be substantial to justify the added costs.

3. Previous research

Studies have found positive and persistent effects of preschool on cognitive and social development (Barnett, 2002). However, relatively few studies have investigated how effects vary with the characteristics of the population served, the program or the societal context. Higher quality studies with independent information on the programs and validated measures of program participation rather than parent report are even less common. Selection bias is a threat for many studies, and heavy attrition may afflict large-scale longitudinal studies. Two recent studies are exceptionally rigorous. A study of Oklahoma's universal 4-yr-old program employing a regression discontinuity design finds positive effects for all children on language, literacy and math skills at kindergarten entry (Gormley, Gayer, Phillips, & Dawson, 2005). In contrast, a nationwide Head Start impact study utilizing random assignment found relatively small effects on language and literacy (and no effects on math) after 1 yr in the program at age 3 or 4 (Puma, Bell, Cook, Heid, & Lopez, 2005).

For our purposes, the most distinctive features of the Abecedarian program are the large number of hours per year and the many years that children were in attendance. Few children experience this amount of child care, and even then they often experience frequent changes in care arrangements and/or caregivers (Witte & Trowbridge, in press). Comparisons of outcomes across randomized trials indicate that the only programs demonstrating permanent gains in IQ and achievement test scores are those offering sustained, intensive service (Barnett, 1998). Effects on school outcomes such as grade retention, special education and high school graduation do not differ greatly according to program intensity. Possible explanations for this are either that: these outcomes are sensitive to variations in policies across schools and school districts; or these measures represent thresholds to be crossed rather than levels of ability or achievement.

Two recent large-scale studies estimated the effects of different amounts and types of early care and education on learning and development based on natural variation. A national study of children attending preschool programs in England found that number of months in attendance predicted growth on cognitive development (Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004). Children who entered a preschool program before age $2\frac{1}{2}$ gained more than those who entered later. In follow-up through age 7, months of preschool participation and educational quality both continued to predict gains in reading and math.[3] Similar findings are reported by the NICHD study of early child care in the United States, though this study emphasizes the contribution of long hours, i.e. more than 30 h per week (NICHD & Duncan, 2003; NICHD and ECCRN (2003)).

4. Abecedarian project

This paper's information on the costs and benefits of investing in the joint production of child care and early education of children from low-income families comes from a unique experiment, the Abecedarian study (see Campbell, Helms, Sparling, & Ramey, 1998). The study randomly assigned to a treatment or control condition 112 children, mostly African American, born between 1972 and 1977 and who were believed to be at risk of retarded intellectual and social development. Family

[3]The only long-term result for socialization was that participation prior to age 2 was associated with slight negative effects on anti-social behavior (though preschool participation was associated with positive effects on several other dimensions of social and emotional development up to age 6).

background characteristics at study entry were: maternal education of approximately 10 yr, maternal IQ of 85, 25% of households with both parents, and 55% of households receiving Aid to Families with Dependent Children. Random assignment occurred between 6 and 12 weeks of age. By 1978, 104 participants remained in the study, and the follow-up at age 21 involved all 104 of these participants.

The preschool program was center-based with teacher/child ratios that ranged from 1:3 for infants/toddlers to 1:6 for older children. The center was operated from 7:30 a.m. to 5:30 p.m., 5 days per week, and 50 weeks out of the year, with free transportation available. This constitutes 2500 h/yr and is compatible with the needs of most full-time working parents, in contrast to the typical part-day preschool program which might provide 450–540 h/yr (2.5–3 h/day, 180 days). The curricula are called "Learningames, The Abecedarian Curriculum" and "Partners for Learning" (see Ramey & Ramey, 1998). The curriculum emphasized language development, but addressed all developmental domains.[4]

Early assessments indicated substantial early gains in IQ and achievement and the most recent assessment at age 21 found continued effects on IQ and achievement, though effects on IQ appear to have declined and then stabilized at about 5 points (Campbell et al., 2002). Effects on school success include much lower levels of grade retention ($E = 34\%$, $C = 65\%$); placements in special education classes ($E = 31\%$, $C = 49\%$); reduced high school dropout ($E = 33\%$, $C = 49\%$) and a higher rate of attending a 4 yr college at age 21 ($E = 36\%$, $C = 13\%$). Researchers examined the relationship between program participation and the incidence of youth crime to an average age of 21 and shows no statistically significant differences (Clarke & Campbell, 1998). This finding differs from those of long-term follow-up studies of part-day preschool programs for children at ages 3 and 4 (Barnett, 1998).[5]

[4]Children also received medical and nutritional services. In order to avoid the confounding effects of these factors on intellectual development, the same medical and nutritional services were provided to the children in the control group.

[5]Although extensive data on social and emotional development were not collected in the Abecedarian study, some data were collected on behavior as the initial waves of children entered the first 3 grades of elementary school. These early results indicated that children from the Abecedarian program were more aggressive (e.g., kicking, hitting, etc.) than the control children (Haskins, 1985). This finding is in sharp contrast to evidence of better behavior in the early grades of school for children who

Table 1
Present value of Abecedarian benefits and costs per child (2002 dollars)

	Discount rate (%)		
	3	5	7
Program cost (net)	$35,864	$34,599	$33,421
Program benefits			
Part. earnings	37,531	16,460	6376
Earnings of future generations	5722	1586	479
Maternal earnings	68,728	48,496	35,560
K-12 education	8836	7375	6205
Smoking/health	17,781	4166	1008
Higher education costs	−8128	−5621	−3920
AFDC	196	129	85
Total benefits	$130,666	$72,591	$45,793
Net present value	$94,802	$37,992	$12,372

5. Benefit–cost analysis

Benefit–cost analysis of the Abecedarian program followed standard procedures (Levin & McEwan, 2001) and is methodologically comparable with benefit–cost analyses of the Perry Preschool program (Barnett, 1996; Nores, Barnett, Belfield, & Schweinhart, 2005). Although minor differences in assumptions and in the specific outcomes measured between the two studies produce some differences in the analyses, these do not materially affect the comparisons of interest in this paper. A preliminary version of the Abecedarian benefit–cost analysis gives a complete explication of method (Masse & Barnett, 2002). Thus, methods are discussed only briefly here, with emphasis on issues of particular importance to this paper's focus.

Costs were estimated based on a program description and records obtained from those who operated the program. 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. Estimated benefits for crime and delinquency are effectively zero, given a lack of effects. All estimated benefits and costs were deflated and discounted. Table 1 reports estimates

(*footnote continued*)
attended part-day preschool interventions that generally began at ages 3 and 4 (Barnett, 1998; Barnett, Young, & Schweinhart, 1998).

of the present value of program costs and benefits in 2002 dollars discounted at real rates of 3%, 5% and 7%.

5.1. Program costs

The estimated cost of providing the Abecedarian program is $11,000 in year one, $16,000 in years two and three, and $12,000 in years four and five. The estimated undiscounted cost for the program is therefore approximately $67,000.[6] Cost was estimated as the marginal cost of the Abecedarian treatment over the cost of child care arrangements experienced by the control group, which experienced a mix of formal and informal care for 40 h including parental care. This required estimates for the parental component of care that were then combined with the estimates for non-parental care. Average cost of care for the control group was subtracted from average cost of care for the treatment group children to estimate net cost for each year. Average net yearly cost is estimated to be $8849 in a public school setting.

5.2. Participant earnings

Gross earnings are forecast on the basis of educational attainment (Miller & Hornseth, 1967). Census data are used to estimate future earnings by age, race and gender for various categories of educational attainment; and each individual's estimated lifetime income depends on educational attainment at age 21 and the probability of higher educational attainment later in life. The program effect on lifetime compensation beyond age 21 is approximately $37,500 at a discount rate of 3%. This includes base salary and fringe and employer-provided benefits that are valued at 20% of base salary. Overall, lifetime compensation beyond age 21 is conservatively estimated. The use of cross-sectional data assumes that age–earnings profiles are relatively stable over time. However, the labor force participation rates of women have shown a significant upward trend over the past 50 yr for women of all ages (Fullerton, 1999). Therefore, projecting female earnings based on cross-sectional data is conservative and leads to estimates that are below the actual earnings that will be realized by program participants.

5.3. Earnings of future generations

The mechanisms through which benefits from the preschool program might be transmitted across generations include effects on intelligence and academic achievement, educational attainment, earnings, occupation, reliance on welfare, fertility behavior (e.g., timing and spacing of births) and health (Belfield, 2005). This analysis relies only on the program effect on income and evidence of a positive relationship between parental income and the income of children. Specifically, the program's effect on the earnings of future generations was estimated employing elasticity estimates from Altonji and Dunn (1990). The estimated elasticity of the income of a son (daughter) with respect to the income of the father is equal to 0.210 (0.335). The estimated elasticity of the income of a son (daughter) with respect to the income of the mother is equal to 0.148 (0.348).[7] As shown in Table 1, the program effect on the gross earnings of future generations was estimated at $5700 given a discount rate of 3%.

5.4. Elementary and secondary education

The effects of the program on the elementary and secondary education costs of participants were estimated. School histories were constructed for 99 of the study participants based on official school record data. For each participant for each year, a school placement was assigned. The major distinction was between special education placements and regular educational placements, with the former being more resource intensive and, hence, more costly. Cost estimates for each type of placement were mapped on to the histories to calculate total schooling costs.[8]

[6] Average enrollment in the nursery was about 12 infants and the staff/child ratio was 1:3. Average age at entry was 4.4 months. In program years two and three group size averaged about seven children for both age groups and the staff/child ratio was 1:3.5. In program years four and five the average was 12 children per group at each age, and the staff/child ratio was 1:6.

[7] It is assumed, conservatively, that each participant (parent) has one child at age 25 and that the child has earned income from age 22 to age 65.

[8] Program effects on schooling costs are less than one might expect from grade repetition and special education comparisons because cost is tied more closely to the percentage of total school years in special education than the percentage ever in special education and because program children are less likely to drop out.

5.5. Smoking and health

Schooling is related to an individual's ability to obtain and process information related to matters of health (Grossman & Kaestner, 1997). Better-educated individuals can make more informed and better decisions regarding their personal health. Education increases the ability to be an effective consumer of health care services and producer of personal health. Education also increases income, allowing one to buy higher quality and quantity of health services and to establish healthier living conditions.

Health information from the current study is limited to smoking behavior, taken from a 1993 youth risk behavior survey. The rates of smoking for the control group and program group were 55% and 39%, respectively ($p = .106$). The results are clearly suggestive, though not statistically significant. For this analysis, effects on morbidity (illness) prior to death are ignored and only the effects on expected mortality are estimated. Following Cutler et al. (2000), the estimated value of a year of life employed is $150,000 (1999 dollars). The program effect on mortality due to decreased smoking is therefore estimated at approximately $17,800 at a discount rate of 3%.

5.6. Primary caregiver's (maternal) labor supply and earnings

An important benefit of fully subsidized full-day, year-round preschool is the educational and labor market success of participant's mothers. A number of researchers have taken up this issue, but it is difficult to produce convincing estimates of the effects of subsidies for early childhood care and education on parental employment. One usually must rely on econometric estimates of how much any given policy change will influence employment, and these estimates are highly sensitive to assumptions about measures, the specification of equations and the sources of data (Kimmel, 1998). To date, there is no other experimental evidence to bring to bear.[9]

Critically, labor supply effects may differ depending on the quality of the preschool program provided. Custodial care, with less attention to education, could produce a much smaller response. The stability and general quality of child care arrangements may influence mothers' ability to concentrate on matters related to work or employment (Vandell & Wolfe, 2002). Also, parents may factor in to some extent the likely costs to their children in terms of quality of life and development. In the current study, the provision of 5 yr of high-quality, full-time care and education appears to have increased the opportunities of mothers to obtain employment, training and other productivity-enhancing activities. Campbell and Ramey (1994) reported that the experimental group mothers had higher levels of educational attainment and held higher-paying jobs when their children were age 5.

Self-report data are available at (roughly) ages 32, 35 and 41 for gross earnings of the primary caregiver (in most cases, the biological mother). The program effect is estimated by regressing a measure of earnings against a dichotomous variable for program group using ordinary least squares. Separate regressions on each year's data generally yield a positive program effect but have a substantial number of missing cases and do not achieve statistical significance. Thus, we examine effects on average earnings across the three survey years, which provides more cases and greater reliability.

The estimated program effect on primary caregiver's mean earnings is $4310 ($p = .025$, $N = 101$, $R^2 = .040$) when earnings are averaged across all available cases over 1–3 yr and missing data for 1 or 2 years are ignored. The program effect on primary caregiver mean earnings is $3085 ($p = .012$, $N = 101$, $R^2 = .053$) when earnings are averaged across all 3 yr and missing data for 1 or 2 years are replaced with mean earnings.[10] Overall, the analysis supports an effect on primary caregiver's gross earnings that is conservatively estimated at $3000

[9] Recent estimates of the elasticity of the maternal labor supply with respect to the price of child care that account for work intensity have produced elasticity estimates ranging from −0.78 to close to 0 (Averett, Peters, & Waldman, 1997). However, the elasticity of labor supply appears to vary across population groups, with employment of low-income women more responsive than the average. GAO (1994) estimates that free child care would increase labor force participation of all poor mothers from 29% to 44%, a 52% change in employment. Blau and Hagy (1998) estimate that the full funding of child care by the government would result in a 10% increase in overall maternal employment.

[10] Restricting the sample to biological mothers resulted in a significant loss in sample size. Comparable estimates for biological mothers only are $3700 ($p = .100$, $N = 73$, $R^2 = .04$) and $3300 ($p = .027$, $N = 73$, $R^2 = .05$).

per year. Assuming a 20% rate of fringe benefits, the total program effect on maternal compensation from age 26 to age 60 is approximately $69,000 at a discount rate of 3%. Program effects from age 26 through age 41 are estimated based on reported earnings at ages of 32, 35 and 41. Program effects from ages 42 to 60 are extrapolations and assume no increase in the earnings differential between the two groups. Due to a lack of earlier data on maternal earnings, we do not estimate an effect on earnings prior to age 26 (the average maternal age at program exit), even though that is the period when the free child care was actually received. Notably, this estimated program effect on earnings is consistent with the econometric estimates reviewed above.

5.7. Cost of higher education

The program group participants have higher levels of educational attainment at age 21. This reflects higher academic achievement and is assumed to result in higher individual earnings. However, the cost of attending institutions of higher education must be counted. Since the program group has a higher rate of higher education enrollment, the program effect due to this cost will be negative.

The estimated costs of additional higher education are included in Table 1. The effects are fairly significant in size due to the large differences in the educational attainment of the program and control groups. The increase in cost due to higher education is approximately $8128 at a 3% rate of discount. The effects due to the cost of higher education decrease overall program benefits and are therefore negative in value. No costs are included for other adult education given low rates of participation and lack of substantive differences between groups (11% vs. 15%).

5.8. Income-tested programs at age 21

A reduction in welfare payments to program participants represents a transfer of money to the general taxpayer and does not change total social benefits associated with the program. Thus, the benefits to society as a whole are limited to the reduction in costs associated with administering the program. Information on effects on welfare payments consists of reported use of Aid to Families with Dependent Children (AFDC) at age 21. Rates of AFDC use for the program and control groups were 8% and 16% ($p = .23$). Although not statistically significant, the point estimate warrants an investigation.

Total welfare program participation was estimated based on AFDC participation and the value of subsidies from other income-tested programs received by households that participated in AFDC programs in 1995 (see Committee on Ways and Means, 1998). The average value of total assistance per AFDC household is $10,715 (2002 dollars). Assumptions were made about later entry and exit based on past experience and current welfare program rules. As reported in Table 1, the overall benefit discounted at 3% is estimated to be just $196 per participant. This represents only administrative savings. It does not include any estimated deadweight loss from raising government revenues to pay benefits and administrative costs, but even this would not make the benefit large. Unmeasured benefits that include psychological benefits to participants and their families from decreased reliance on social assistance could be substantial, but are unknown.

5.9. Net present value

The bottom line of Table 1 reports the net present value of benefits and costs at three different rates of discount. Estimated net present value is positive at rates of return exceeding 7%. These results were obtained even though many benefits associated with improved education went unmeasured.[11] Moreover, an important goal of the program was to improve the social and economic prospects of a disadvantaged group. The Abecedarian program's effects on educational attainment, productivity and earnings improved overall social equity. Improvements in equity remain a potentially large unmeasured benefit of the Abecedarian program.

This analysis does not estimate deadweight losses associated with raising revenue to pay for the program or reductions in such losses associated with benefits that reduce public expenditures or permit revenue neutral decreases in tax rates. It can be argued that such analyses are unnecessary, but at the very least there is considerable uncertainty

[11] These might include the personal consumption value of learning and education, increased civic and pro-social behavior, improved quality of life, and improved decision-making and household management (Haveman & Wolfe, 1984).

involved in estimating such effects (Ng, 2000). As the Abecedarian program's net effect on the tax burden is estimated to be small (depending on assumptions about cost savings from reduced smoking), the effect of accounting for deadweight loss would be quite small. Thus, it is safely ignored here regardless of one's view about excess burden.

Some of the benefits and costs accrue to the program participants and some to the general public and the distribution of benefits and costs is important to the political viability of an instrument of public policy. A relevant question is whether or not society realizes returns in excess of public funds and resources that are dedicated to the program. As discussed, the Abecedarian program does "pay for itself" at high rates of discount when all benefits and costs are included. However, the benefits primarily accrue to poor taxpayers. Masse (2002) estimates that taxpayers would have to value these benefits at approximately $100 (per taxpaying household) for benefits to the taxpayers to equal program costs at a discount rate of 3%. Given the importance assigned to equal opportunity in our society and the costs of alternative policies addressing this goal, this might be considered a bargain.

Table 2
Benefit–cost comparisons for the Perry and Abecedarian studies (2002 dollars discounted at 3%)

	Perry	Abecedarian
Program cost	$15,386	$63,476
Benefits		
Child care	919	*27,612*
Compensation	79,743	37,531
K-12 schooling	8556	8836
College/adult ed.	−1309	−8128
Crime	173,959	0
Welfare	774	196
Compensation future gen.	?	5722
Maternal compensation	0	68,728
Health/smoking	?	17,781
Total benefits	$262,642	$158,278
Net present value	$247,256	$94,802
Benefit-cost ratio	9:1	2.5:1

6. Comparative analysis, interpretation and generalization

The current study is one small, randomized trial in a particular time and place. How far is it likely to generalize? What can we learn about designing more efficient public policies from this study in the context of the larger literature briefly reviewed earlier? To evaluate potential generalizations one must have information on the extent to which the results are sensitive to variations in: treatment (process), who is served (person) and broader social and economic conditions (context). Thus, it is useful to look across studies to judge how results are affected by characteristics of the programs, the populations served and the broader contexts. To assist with this, comparisons are provided in Tables 2 and 3 to the results of the Perry Preschool study. The Perry study is the only other randomized trial of preschool education with follow-up through adulthood and a benefit–cost analysis.

Only programs of similar intensity and duration starting in the first year of life and continuing to kindergarten entry have been found to produce the sustained effects on IQ and the large effects on achievement seen here (Barnett, 1998). Comparisons to the relatively small effects found for ordinary child care experiences and part-day preschool programs are informative. None of these other types of programs produce persistent IQ gains. Ordinary child care even if it starts quite early has effects on achievement that are roughly an order of magnitude smaller. Achievement gains from part-day preschool beginning at ages 3 or 4 are perhaps half as large as those of the Abecedarian study.

Although the effects on cognitive abilities are unusually large, the effects on the costs of K-12 schooling are not (Table 2). Table 3 provides insights into why this is the case by comparing educational effects of the half-day Perry Preschool program. As can be seen, the Abecedarian program had much larger effects on grade repetition and on whether a child ever received special education. However, these do not affect educational costs as much as the number of years spent in special education, and there the Perry Preschool program has larger effects. It seems likely that this results from differences in the populations served or context. The Abecedarian control group had higher IQ's and achievement test scores than the Perry control group. Perhaps the Abecedarian children were better off to start with (Perry children were selected for low IQ), or perhaps their school system (Chapel Hill, NC) contributed more to child development beginning in kindergarten. In either case, the Abecedarian children appear to have less

Table 3
Comparison of Abecedarian and Perry program effects

Outcome	Abecedarian		Perry	
	Treatment	Control	Treatment	Control
IQ Age 3	101	84	96	83
IQ Age 4.5	101	91	95	84
IQ Age 14/15	95	90	81	81
Reading achievement age 14/15	94	88		
Math achievement age 14/15	93	82		
Ever repeated grade (%)	34	65	15	20
Ever in special education (%)	31	49	37	50
Percent of years in special ed. (%)	12	18	16	28
High school graduation by age 19 (%)	67	51	66	45
College attendance (%)	36	13	9	5
Smoking (%)	39	55	42	55

Note: Sources for Perry data are Schweinhart, Barnes, and Weikart (1993) and Schweinhart et al. (2005). For Abecedarian program, all differences between groups are significant at $p < .05$, except IQ at age 15 and Ever in special education, High School Graduation by age 19, and Smoking. Data are from Campbell and Ramey (1995), Ramey and Campbell (1984), Clarke and Campbell (1998), Campbell, Ramey, Pungello, Sparling, and Miller-Johnson (2002), and our own analyses.

need for many years of special education even without the intervention.

The consequences of educational effects differ between the two programs when it comes to higher education. The two studies do not report readily comparable statistics on higher education participation, but the benefit–cost analysis shows a large difference. There is no meaningful effect on cost of higher education in the Perry study, but the effect on higher education cost is as large as the K-12 cost effect in Abecedarian. It seems likely that this difference is at least partly due to the larger cognitive gains in the Abecedarian study, but it may also be because this group did not have as far to go in terms of improved achievement to reach levels required for college success.

Some of the other differences between the two studies in Table 2 are more readily attributed to specific program characteristics. Obviously, the duration of the Abecedarian program is closely linked to its child care benefits (offsetting other current expenditures for child care) and to increasing maternal employment. The half-day Perry program for 3- and 4-yr olds produced tiny child care benefits and no effects on maternal earnings. Parents in the Perry study actually found the program to interfere with employment, if anything (Schweinhart et al., 2005). The Abecedarian program provided a tremendous amount of care, the combined benefits of which are approximately $100,000 discounted at 3%. Public programs that do not provide useful child care while delivering preschool education forgo a substantial potential economic return. While such benefits would be smaller across a more general population where all mothers are not seeking full-time employment, our Abecedarian estimates are low because they do not include maternal employment benefits over the first 10 yr.

The other important difference is the absence of any crime benefits for the Abecedarian program compared to nearly $175,000 in crime reduction benefits from the Perry program. It is possible that this is a curriculum effect. Other studies have demonstrated that one curriculum can produce strong cognitive gains without producing improvements in social/emotional development and prosocial behavior, while an alternative yields both (Schweinhart & Weikart, 1997).[12] Another explanation is that there simply was not much crime to prevent: Ramey et al. (2000) report that the Abecedarian households were located in a relatively affluent area and that the community was unusually responsive to the needs of their poorest members. A comparison of the crime rates for the respective cities (Ypsilanti, MI, and Chapel Hill, NC) for the

[12]Although some studies have found long hours in typical child care, especially at very young ages, to be associated with adverse effects on social and emotional development, these adverse effects of long hours are too small to explain the difference between the Abecedarian and Perry studies.

years when the average preschool participant in each study was approximately 15 yr of age is suggestive: Ypsilanti had a crime rate that was 70% higher than in Chapel Hill (FBI, 1981, 1991). Also, differences in the families and children may account for the differences in results.

Nevertheless, it seems prudent to acknowledge that (at best) children learn what they are taught. Preschool curricula that do not effectively address social and emotional development are likely to forego substantial benefits, even though the economic benefits will vary based on the rates of delinquent behavior and crime for various populations and locations. The situation with respect to other types of benefits, including schooling, is not dissimilar. Finally, even though it appears possible to greatly enhance social outcomes while giving up little in the way of cognitive gains, it also would be possible to make the mistake of employing a curriculum that ignored cognitive development while focusing on social development or to be ineffective in both domains.

Several other differences in Table 2 are more apparent than real, and illustrate why caution is required when comparing across studies. No benefits were estimated for smoking reduction in the Perry study, even though the estimated underlying effect was quite similar. Thus, the Perry program should be credited with roughly the same economic benefit. Similarly, benefits to future generations are not included in the Perry benefit–cost analysis. Also, the much larger benefit in participant earnings for the Perry study is likely due to the availability of actual earnings data up to age 40. These produce considerably larger estimates of benefits than projections based on educational attainment. The Abecedarian study relied on relatively conservative projections. Given the educational results, it would be premature and probably incorrect to interpret the benefit–cost analyses as evidence that the Perry program produced larger earnings gains.

7. Discussion

The Abecedarian preschool program was educationally intensive and temporally extensive. It likely represents an upper bound on public investments in preschool education that might be realistically considered. Despite its high cost, the program passes a basic benefit–cost test at discount rates of 3–7%. Given the estimated net present value at 7%, and the benefits we were not able to include in the analysis, the internal rate of return to the program could be considerably higher. This study adds to the evidence that preschool education for children in low-income families can be a good public investment. Moreover, there are many reasons why such investments may not be safely left to private sector, such as large externalities, information asymmetries, credit constraints and incomplete altruism (Barnett & Ackerman, 2005). It is demonstrably the case that these programs are not now provided to low-income families by the private sector.

We noted earlier that the benefits from the extra hours provided by a full-day year-round program would have to be large to justify the additional costs. Our analysis indicates that this is the case, if provided to a population that will make maximum use of these hours in the labor market. In the post-welfare reform era, this would seem to be a large segment of the low-income population with young children. The earnings gains for mothers are substantial. It is less clear how much is gained from the hours in terms of benefits to children, though the evidence is supportive here, as well. The economic consequences for children should become clearer as the participants in the Abecedarian study move beyond college and generate adult earnings streams.

Comparison of our results with other studies leads us to recommend that policy makers attend to quality, including the curriculum, as well as quantity. Federal policy over the past decade has vastly expanded public subsidies for low-cost child care (including informal arrangements) thereby producing substantial gains in the utilization of human capital, particularly for low-income women (Haveman, Bershadker, & Schwabish, 2003). However, these child care programs produce little, if any, of the benefits for children itemized in Table 3 (Magnuson, Ruhm, & Waldfogel, 2004). The magnitude of the educational benefits found in the Perry and Abecedarian studies indicates that current child care policies are not economically efficient.

The Abecedarian program also had strong supervision, a well-designed curriculum, well-compensated staff (comparable to the public schools) and on-going evaluation. Yet, the program did not produce gains in social and emotional development that elsewhere have been found to account for a very large portion of potential benefits. Although we cannot with certainty ascribe this result to the curriculum, it is clear that careful consideration should be given to the content and methods of any

preschool program to ensure that it is capable of producing the desired positive effects on cognitive and socio-emotional development.

In the context of the broader literature, it is possible to make some educated guesses regarding the benefits of preschool programs for broader populations. Preschool programs appear to have smaller effects on children higher up the income ladder. The problems that give rise to large externalities—school failure and crime—are less common higher up the income ladder. However, these effects and problems do not abruptly cease at the poverty line, and even if benefits fell to half at the median income they could more than justify a public program for much of the population [Barnett (2004) shows how universal preschooling could be more efficient than one targeting children in poverty]. However, an efficient public preschool program (universal or targeted) would not be uniform, but would need to be tailored for various children and families served with respect to schedule, intensity and, perhaps, sliding fee scale.

Additional research would be useful in developing more efficient preschool policies and programs. There is a tremendous territory to be studied between the programs like Perry and Abecedarian-like programs. Also, few studies provide rigorous estimates of effects on children from across the general population. More should be learned about the process of producing the desired results for various populations. Collaborations between economists and the educators and psychologists with a long tradition of studying the effects of alternative approaches to educating young children might be especially productive.

Finally, our work suggests an important caution for those interpreting benefit–cost analyses of human capital investments generally and a recommendation for future research. One is that simple comparisons can be misleading. Despite many similarities, the results of the Abecedarian and Perry benefit–cost studies differ due to differences in the types of benefits chosen for inclusion and methods of estimation, as well as "real" differences in outcomes. Even real differences may be due to differences in the population served or circumstances rather than differences in the programs. This provides a warning against simple comparisons of economic returns across studies. Thus, when comparing preschool programs with human capital investments in older children (e.g., Heckman & Krueger, 2004), it should be recognized that studies of the latter rarely include anything beyond earnings benefits. Perhaps human capital investments in older children and adults produce few of the other benefits found for preschool programs, but for the most part economists have just not included these other benefits in their estimates. Studies that consider broader estimates of the returns, as is done for preschool programs, could add significantly to knowledge of the returns across human capital investments.

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