

Commission to Develop a Strategic Priorities Plan for Maine's Young Children

Economic Returns to Investment in Early Care & Education

James Heckman

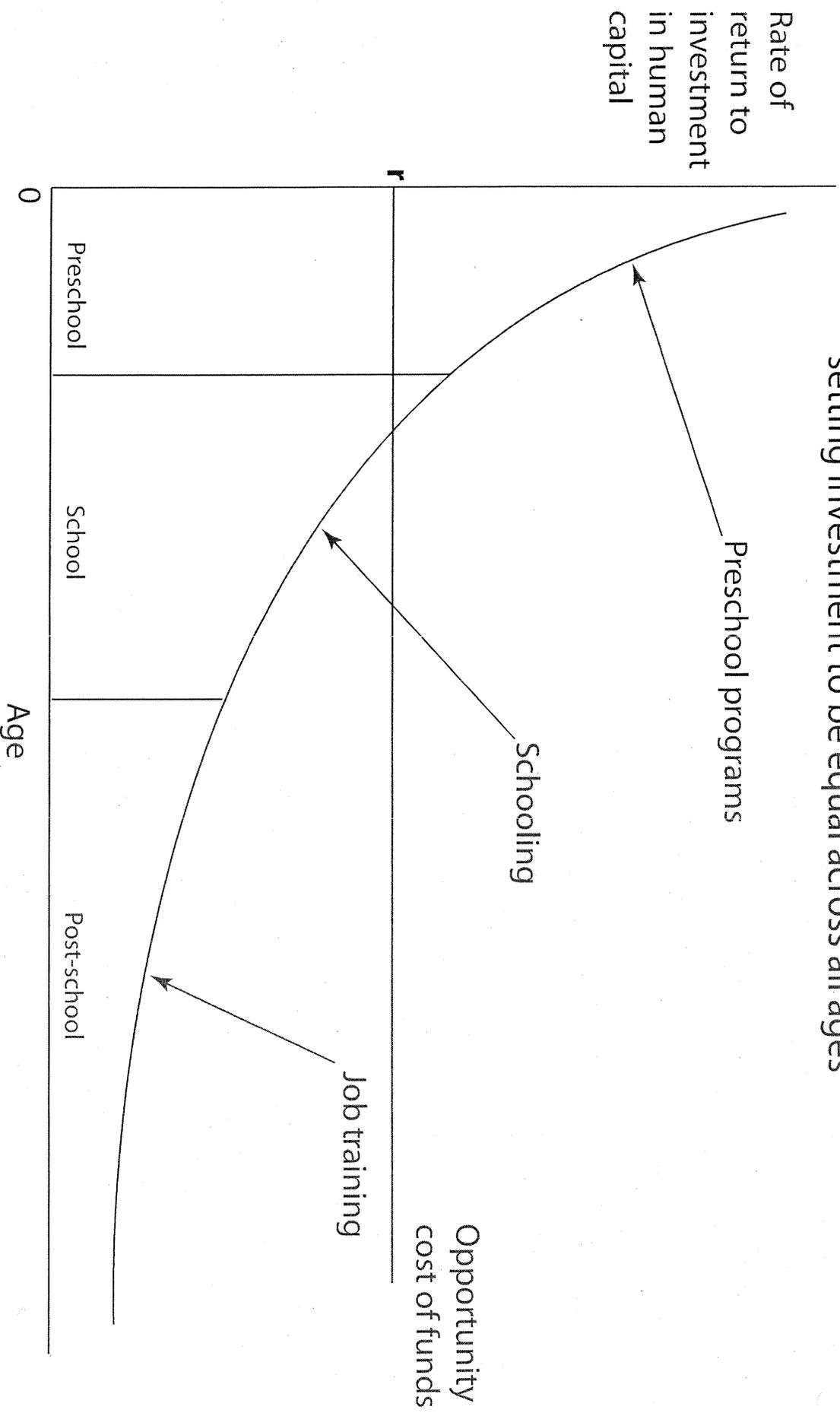
- Nobel prize winning economist; received the *2000 Nobel Memorial Prize in Economic Sciences* for his development of theory and methods for analyzing selective samples of microeconomic data
- Professor of Economics, University of Chicago; Director of the Economics Research Center, Department of Economics, University of Chicago; Director of the Center for Social Program Evaluation, Harris School of Public Policy, University of Chicago; Senior Research Fellow, American Bar Foundation

Heckman's Argument

- Early inputs greatly affect productivity of later inputs in the life cycle of human skill formation; "early learning begets later learning"
- Education and human skill are critical to economic productivity and growth
- U.S. economy is facing challenges, including aging of workforce, stagnating educational attendance, slowing growth of workforce quality
- Adverse childhood environments are significant contributors to the nation's problems in education, workforce skills and crime; barrier to strong labor force for the economy
- Both cognitive and noncognitive abilities (motivation, perseverance) are critical determinants of economic success
- Fundamental cognitive and noncognitive abilities are produced in the early childhood years, well before kindergarten
- Voluntary early childhood interventions designed to provide cognitive and noncognitive stimulation and enrichment to children from disadvantaged family environments have demonstrated positive outcomes (educational performance and attainment, less crime, less welfare dependence), high benefit-cost ratios and high rates of return
- Early childhood interventions have much higher returns than later remedial interventions (in schools, job training, criminal rehabilitation); this is explained by the technology of skill formation -- learning and motivation are dynamic, cumulative processes
- The optimal investment profile declines with age; this holds for all children but more advantaged children benefit from parental/family investments, while disadvantaged children do not
- Directing funds to early childhood interventions for disadvantaged children is a sound economic investment (Figure 7)

Figure 7

Rates of return to human capital investment initially setting investment to be equal across all ages



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Selected quotations from Heckman papers:

- ***Plant seed early:*** “How is it possible to avoid the equity-efficiency tradeoff that plagues so many policies – for example, tax policy or welfare policy? The reason lies in the importance of skills in the modern economy and the dynamic nature of the skill acquisition process. A large body of research in social science, psychology and neuroscience shows that skill begets skill; that learning begets learning. The earlier the seed is planted and watered, the faster and larger it grows.” (3; p.1)
- ***Impoverished early environments:*** “Impoverished early environments are powerful predictors of adult failure on a number of social and economic dimensions. Impoverishment is not so much about the lack of money as it is about the lack of cognitive and noncognitive stimulation given to young children. Experimental interventions that enrich early childhood environments produce more successful adults. These interventions raise both cognitive and noncognitive skills.” (3; p.2)
- ***Importance of noncognitive abilities:*** “Much public policy discussion is focused on cognitive test score measurements, even though cognitive test scores miss important aspects of human development. Cognitive and noncognitive ability are both important in explaining schooling, crime and a variety of other outcomes. Noncognitive ability is neglected in many public policy discussions regarding early childhood. Yet noncognitive ability is a major determinant of socioeconomic success...” (3, p.4-5)

“Extensive evidence indicates that cognitive, social, and emotional capacities play important roles in the attainment of adult economic productivity, and all are shaped by early life experiences.” (2; p.10155)

- ***Roots of human skill formation:*** “Our logic is simple and compelling. Education and human skill are major factors determining productivity, both in the workplace and in society. The family is a major producer of the skills and motivation required for producing successful students and workers. The most effective policy for improving the performance of schools is supplementing the childrearing resources of the disadvantaged families sending children to the schools.” (1; p.4-5)
- ***Technology of human skill formation:*** “The policy implications of the emerging body of evidence on the technology of human skill formation are substantial. Conventional school-based policies start too late to effectively remedy early deficits, although they can do some good. The best way to improve the schools is to improve the early environments of the children sent to them.” (1; p.21-22)

“The economic return to early interventions is high. The return to later intervention is lower. The reason for this relationship is the technology of skill formation. Skill begets skill and early skill makes later skill acquisition easier. Remedial programs in the

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adolescent and young adult years are much more costly in producing the same level of skill attainment in adulthood. Most are economically inefficient.” (3; p.7)

- ***Economically efficient to invest early:*** “The dynamics of human skill formation as analyzed in Cunha and Heckman (2003) and Cunha, Heckman, Lochner, and Masterov (2006) reveal that later compensation for deficient early family environments is very costly. Lack of early skill and motivation begets lack of future skill and motivation. If we wait too long to compensate, it is economically inefficient to invest in the skills of the disadvantaged. A serious tradeoff exists between equity and efficiency for adolescent and young adult skill policies. There is no such tradeoff for policies targeted toward disadvantaged young children.” (3; p.7)
- ***Self productivity of early investment:*** “Cunha and Heckman (2007), and Cunha, Heckman, and Schennach formalize the technology of skill formation by families and estimate empirical models of dynamic skill formation. They show that investments in children are complementary and that early investments improve the return on later investments. The self productivity of early investment warrants more investment in the young.” (1; p.23-24)
- ***Value of targeting disadvantaged families:*** A large body of literature, surveyed in Carneiro and Heckman (2003) and Cunha, et al., demonstrates that skill gaps open up early, before schooling begins, and that these gaps are major determinants of social and economic success. The strong association between family characteristics and child performance measured by cognitive and noncognitive skills also demonstrates the value of a strategy targeted toward disadvantaged families. (1; p.21)
- ***Evidence supports enriched preschool coupled with home visitation:*** “An emerging body of evidence suggests that there is a better way to improve the early years of disadvantaged children. Enriched preschool centers available to disadvantaged children on a voluntary basis coupled with home visitation programs have a strong track record of promoting achievement for disadvantaged children. The economic return to these programs is high, especially when we consider alternative policies that target children from disadvantaged environments or the policies targeted to the young adults who emerge from them.” (1; p.4)
- ***Importance of high quality interventions.*** early childhood experience has a powerful influence on the development of the cognitive, social, and emotional capacities that are prerequisites for strong economic productivity in adulthood. It is important to note, however, that the most convincing data for this assertion come from high quality intervention programs, which are not representative of the effectiveness of a wide range of services typically available to children from disadvantaged environments.
- ***Current under-investment in disadvantaged children:*** “At current levels of public support, America under-invests in the early years of its disadvantaged children.

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Redirecting funds toward the early years is a sound investment in the productivity and safety of American society, and also removes a powerful source of inequality.” (1; p.36)

- ***Such investment promotes both equity and economic productivity:*** “It is a rare public policy initiative that promotes fairness and social justice and at the same time promotes productivity in the economy and in society at large. Investing in disadvantaged young children is such a policy.” (3; p.2)
- ***School-based intervention is too late:*** A large body of empirical work at the interface of neuroscience and social science has established that fundamental cognitive and noncognitive skills are produced in the early years of childhood, long before children start kindergarten. The technology of skill formation developed by economists shows that learning and motivation are dynamic, cumulative processes. Schooling comes too late in the life cycle of the child to be the main locus of remediation for the disadvantaged. Public schools focus only on tested academic knowledge and not the noncognitive behavioral components that are needed for success in life (1; p.24)
- ***Economic, neurobiological, and behavioral perspective:*** A growing proportion of the U.S. workforce will have been raised in disadvantaged environments that are associated with relatively high proportions of individuals with diminished cognitive and social skills. A cross-disciplinary examination of research in economics, developmental psychology, and neurobiology reveals a striking convergence on a set of common principles that account for the potent effects of early environment on the capacity for human skill development. Central to these principles are the findings that early experiences have a uniquely powerful influence on the development of cognitive and social skills and on brain architecture and neurochemistry, that both skill development and brain maturation are hierarchical processes in which higher level functions depend on, and build on, lower level functions, and that the capacity for change in the foundations of human skill development and neural circuitry is highest earlier in life and decreases over time. These findings lead to the conclusion that the most efficient strategy for strengthening the future workforce, both economically and neurobiologically, and improving its quality of life is to invest in the environments of disadvantaged children during the early childhood years. (2; abstract, p.10155)
- ***Invest in disadvantaged children as early as possible:*** “The evidence presented in this paper indicates that the most cost-effective strategy for strengthening the future American workforce is to invest greater human and financial resources in the social and cognitive environments of children who are disadvantaged, beginning as early as possible. The greatest return derives from investing in disadvantaged children because their home environments are impoverished. Therefore, for them, the difference between the stimulating intervention environment and the environment they would otherwise experience is extremely large. In contrast, for typical children, the difference between the intervention environment and the home environment is small or nothing. (2; p.10161)

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[<http://www.pnas.org/cgi/reprint/103/27/10155>]
3. ***“Investing in Disadvantaged Young Children is Economically Efficient Policy”*** James J. Heckman; presented at the Forum on “Building the Economic Case for Investments in Preschool”; Committee for Economic Development, Pew Charitable Trusts, PNC Financial Services Group; January 10, 2006.
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Program Outcomes and Cost/Benefit Estimates for Three Early Childhood Interventions

	Perry Preschool Project	Abecedarian Early Childhood Intervention	The Chicago Child-Parent Center Program
Location	Ypsilanti, MI	North Carolina	Chicago, IL
Date	1962-1967	1972-1985	1967-present
Program Goal	improve the intellectual, social and emotional development of young children who might otherwise not succeed in school	improve school readiness of children from very low-income, multi-risk families by providing high quality educational program	improve the school success of the children, especially school achievement in reading and math; another goal was parent involvement in their children's lives at school
Population	African American children with low IQs (70-85 range) and from families with low socioeconomic status (low education, low occupational status, homes fewer than 3 rooms per person)	Children believed to be at high-risk for limited intellectual and social development based on low socioeconomic status of their families (including: low family income, low parental education, low maternal IQ, single parenthood, parental unemployment, and others)	Children from families of low socioeconomic status that lived in a area served by Federal Title 1 program (funding to public schools serving low-income children)
Enrollment age	3 years old	6-12 weeks old	3-4 years old
Number of children	123	111	5,000 annually
Intervention	Preschool program housed in a public school 2 years (ages 3 and 4) Daily 2.5 hour classes Weekly 1.5 hour home visits - message "you are an important educator of your child" High instructor quality - most had B.A. degrees in education Low student-teacher ratios (average ration 5.7 children to 1 teacher)	Preschool program Full day (7:30-5:30), 5 days/week, 50 weeks/yr 5 years Curriculum stressed language development and attempted to address social development needs Child-staff ratio 3:1 for infants, 4:1 for toddlers, 5:1 for 3-yr olds, 7:1 for 4-yr olds Most teachers had college degrees At age 5 all children reassigned to special "Home School Resource Program" intervention for ages 5-8 or control group; in which parents engaged in supplemental education activities with children in their homes; parents provided educational material and training every 2 weeks by masters/PhD level teacherse	24 centers provide 1/2 day preschool for children ages 3-4 19 of the centers also provide half-day and full-day kindergarten 13 of the centers provide additional educational services through 3rd grade (age 9) Centers emphasize basic language/reading skills and social and psychological development Centers encourage parental involvement Centers provide free breakfast, lunch and health services Mean group size 17 (child:staff ratio 8.5:1)
Follow-up	Annual evaluations through age 11, then again at 14, 15, 19, 27, 40	Data collected at ages 3, 5, 8, 12, 15, 21	Data collected through age 22 (Chicago Longitudinal Study)
Evaluation method	Random assignment	Random assignment	Matched control group by age, eligibility for intervention and family socioeconomic status
Original sample size (program / control)	58 / 65	57 / 54	989 / 550

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OUTCOMES			
Special education services	15% vs. 34% at age 15	12% vs. 48% at age 15	14% vs. 25% at age 18
Grade retention	21% vs. 41% at age 40	31% vs. 55% at age 15	23% vs. 38% at age 15
High school completion	71% vs. 54% at age 27	70% vs. 67% at age 21	66% vs. 54% at age 22
Attended college	33% vs. 28% at age 27	36% vs. 12% at age 21	24% vs. 18% at age 22
Employed	71% vs. 59% at age 27 76% vs. 62% at age 40	70% vs. 58% at age 21	n/a
Monthly earnings	\$1219 vs. \$766 at age 27 \$1,856 vs. \$1,308 at age 40	n/a	n/a
Earning > \$20,000	60% vs. 40% at age 40	n/a	n/a
Owned home	27% vs. 5% at age 27 37% vs. 28% at age 40	n/a	n/a
Ever arrested	32% vs. 48% at age 40	n/a	n/a
BENEFITS per \$1.00 INVESTMENT (2002 dollars)			
	Age 27	Age 22	Age 21
Total Benefit per \$1 invested	\$8.74	\$3.78	\$10.15
Public Benefit	\$7.16	\$2.69	\$6.87
% Public benefit	82%	71%	68%
	Age 40		
Total Benefit per \$1 invested	\$16.14		
Public Benefit	\$12.90		
% Public benefit	80%		
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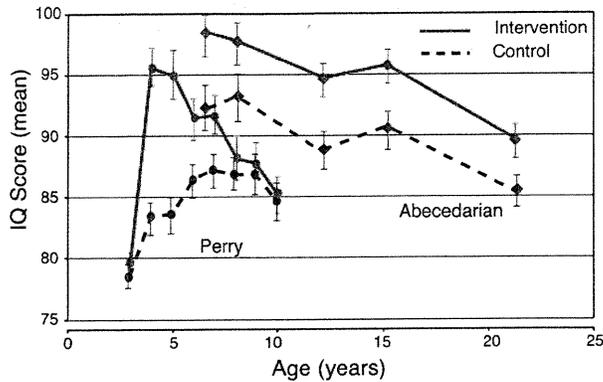


Fig. 1. Mean IQ scores as a function of age for intervention and control groups in the Perry Preschool and Abecedarian Programs. Perry, circles; Abecedarian, diamonds; intervention group, red symbols; matched control group, blue symbols. Bars indicate SEs. Data from High/Scope and from the Carolina Abecedarian Project and the Carolina Approach to Responsive Education, 1972–1992.

Box 1: Early Intervention Programs for Disadvantaged Children. Two different intervention programs, the Perry Preschool Program and the Abecedarian Program, have used randomized child assignment and long-term follow up to study the effects of early interventions on social behaviors of severely disadvantaged children (19, 80). The Perry Program was an intensive preschool program that was administered to 64 disadvantaged, black children in Ypsilanti, MI, between 1962 and 1967 (see *Supporting Materials*, which is published as supporting information on the PNAS web site, for details). The treatment consisted of a daily 2.5-h classroom session on weekday mornings and a weekly 90-min home visit by the teacher on weekday afternoons. The length of each preschool year was 30 weeks. The control and treatment groups have been followed through age 40. The Abecedarian Program involved 111 disadvantaged children, born between 1972 and 1977, whose families scored high on a risk index (see *Supporting Materials* for details). The mean age at entry was 4.4 months. The program was a year-round, full-day intervention that continued through age 8. The children were followed up until age 21, and the project is ongoing.

In both the Perry and Abecedarian Programs, there was a consistent pattern of successful outcomes for treatment group members compared with control group members. For the Perry Program, an initial increase in IQ (Fig. 1, red circles) disappeared gradually over 4 years after the intervention, as has been observed in other studies. However, in the more intense Abecedarian Program, which intervened earlier (starting at age 4 months) and lasted longer (until age 8), the gain in IQ (Fig. 1, red diamonds) persisted into adulthood (21 years old). This early and persistent increase in IQ is important because IQ is a strong predictor of socioeconomic success.

Positive effects of these interventions also were documented for a wide range of social behaviors (Fig. 2). At the oldest ages tested (Perry, 40 yrs; Abecedarian, 21 yrs), individuals scored higher on achievement tests, reached higher levels of education, required less special education, earned higher wages, were more likely to own a home, and were less likely to go on welfare or be incarcerated than individuals from the control groups. Many studies have shown that these aspects of behavior translate directly or indirectly into high economic return. An estimated rate of return (the return per dollar of cost) to the Perry Program is in excess of 17% (19). This high rate of return is much higher than standard returns on stock market equity and suggests that society at large can benefit substantially from these kinds of interventions.

positive effects of early environmental enrichment on a range of cognitive (Fig. 1) and “noncognitive” skills, school achievement, job performance, and social behaviors (Fig. 2), long after the intervention ended (13, 14). Data from noncontrolled assessments of Head Start and the Chicago Child-Parent Centers programs suggest similar conclusions, although the data from Head Start represent only short-term effects.

Several observations regarding the evidence from these intervention studies are relevant to this paper (Fig. 3). First, skills beget skills. That is, all capabilities are built on a foundation of capacities that are developed earlier. This principle stems from two characteristics that are intrinsic to the nature of learning: (i) early learning confers value on acquired skills, which leads to self-reinforcing motivation to learn more, and (ii) early mastery of a range of cognitive, social, and emotional competencies makes learning at later ages more efficient and, therefore, easier and more likely to continue.

Second, early intervention lowers the cost of later investment. For example, young children at risk for school failure who participate in early childhood programs are less likely to repeat grades or to require special education services (Fig. 2), thereby resulting in lower costs to the education system over time.

A more refined analysis of the intervention literature reveals significant increases in achievement across a broad range of outcomes (e.g., academic achievement tests, years of schooling completed, adult wages, and home ownership) among disadvantaged individuals as a result of exposure to an enriched preschool environment (Fig. 2). In most studies, these results are independent of IQ effects and are hypothesized to be related to differ-

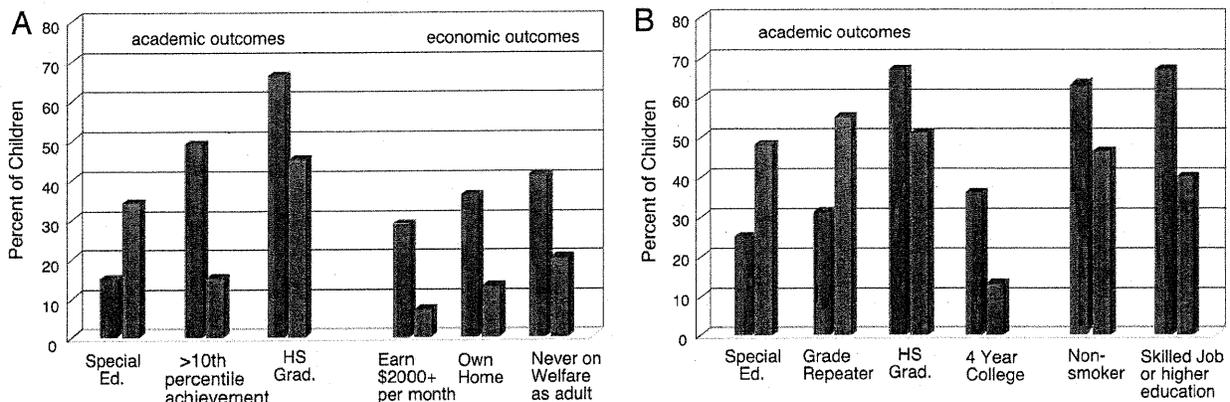
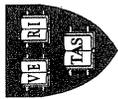


Fig. 2. Academic, economic, and social outcomes for the Perry Preschool and Abecedarian Programs. (A) Data from the Perry Program collected when the individuals were 27 years old (High/Scope). >10th percentile achievement, children who scored above the lowest 10% on the California Achievement Test (1970) at age 14; HS Grad, number of children who graduated high school on time. (B) Data from the Abecedarian Program collected when the individuals were 21 years old (Carolina Abecedarian Project and the Carolina Approach to Responsive Education, 1972–1992). Red bars, intervention group; blue bars, control group.

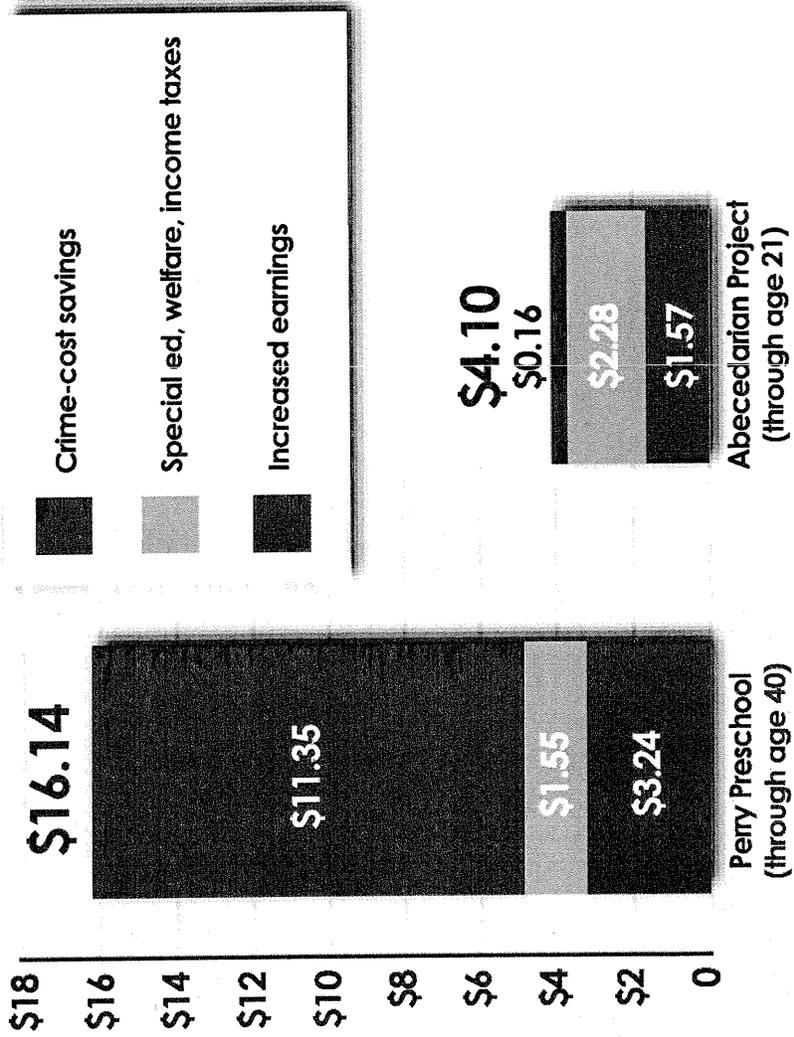


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Cost/Benefit for Two Early Childhood Programs

(Dollars returned for each dollar invested)



Source: Schweinhart, Montie, Xiang, et al. (2005); Masse & Barnett (2002)

