

Cost-Effective Early Childhood Development Programs from Preschool to Third Grade

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Executive Summary

Although findings on the positive effects of early childhood development programs have been widely disseminated, less attention has been given to program impacts across the entire period of early childhood. This review summarizes evidence on the effects and cost-effectiveness of programs and services from ages 3 to 9. The major focus is preschool programs for 3- and 4-year olds, full-day kindergarten, school-age programs including reduced class sizes, and preschool-to-third grade interventions. There is wide variation across states in expenditures for early childhood development programs. Although 38 states fund prekindergarten programs for 4-year-olds, for example, participation rates range from about 2% (Minnesota) to 70% (Oklahoma).

Participation in preschool programs was found to have relatively large and enduring effects on school achievement and child well-being. High-quality programs for children at risk produce strong economic returns ranging from about \$4 per dollar invested to over \$10 per dollar invested. Recent evaluations of state-funded prekindergarten programs show positive and educationally meaningful effects on school readiness skills for both at-risk and not-at-risk children. Policy analyses from state and national perspectives estimate returns of at least \$2 per dollar invested for targeted programs and at least \$2 per dollar invested for universal access programs.

Relative to half-day kindergarten, the positive effects of full-day kindergarten have been found to be relatively small and generally do not last for more than a year. While no formal economic analyses have been conducted, the economic return per dollar invested would be expected to be close to zero, especially if benefits are limited to achievement.

Among school-age programs, preschool plus school-age interventions (PK-3) for children at risk are linked to higher levels of school performance into adolescence. The Child-Parent Center PK-3 Program shows a return of 6 to 9 dollars per dollar invested. Class size reductions show evidence of positive effects with economic returns of roughly 3 dollars per dollar invested. School-based social skills training can yield returns of over 3 dollars per dollar invested while the treatment-focused program Reading Recovery shows only short-term positive effects.

Key principles of effectiveness include the establishment of a coordinated system of services beginning at age 3 and continuing to the early school grades, teaching staff that are well trained and compensated, preferably with earned bachelor's degrees and appropriate certification, comprehensive family services, emphasis on the direct acquisition of school readiness skills and performance, and commitment to on-going evaluation and assessment.

Five policy recommendations are discussed: (1) Establish a state-funded Minnesota prekindergarten program for 4-year-olds following key principles of effectiveness, (2) Increase state investment in evidence-based school transition programs and practices in the early grades, (3) Use results of cost-benefit analysis to prioritize child investment options, (4) Develop funding mechanisms to support the implementation of programs in a more timely manner, and (5) Increase investments in research and development for evaluating programs.

Introduction

The positive effects of early childhood development programs on school readiness and performance have been documented in hundreds of research studies since the 1960s and in dozens of research syntheses (Karloly et al., 2005; Reynolds, Wang, & Walberg, 2003; Zigler, Gilliam, & Jones, 2006). In the past decade, findings of the accumulated evidence have been more widely disseminated to practitioners and policy makers (Carroll et al., 2003; Committee for Economic Development, 2002; Governor's Task Force, 2002). During this time, states began to substantially increase investments in preschool programs for both at-risk children and those at lower risk.

Today 38 states fund voluntary preschool programs for 3- and 4 year-olds. In 2005-2006, state-funded programs served 943,000 children at an annual expenditure of \$3.3 billion dollars (Barnett et al., 2007). This is a 13% increase in expenditures from the previous year. These programs complement the federally-funded Head Start program, early childhood special education, and related investments at the local level. Nationally, 20% of all 4-year-olds attend state-funded prekindergarten programs.

In Minnesota, it is estimated that 2% of all 4-year-olds attended state-funded prekindergarten, which ranks Minnesota 37th out of 38 states in prekindergarten access (Barnett et al., 2007). Among other Midwestern states, Wisconsin ranks 7th with 32% of all 4-year-olds in state-funded programs. Illinois ranks 13th with 23%. The leading states are Oklahoma and Georgia.

In addition, a relatively large percentage of Minnesota children enter kindergarten at suboptimal levels of performance. The Minnesota Department of Education (2007) reported that of 3,000 kindergartners across the state in fall 2006, 54% of kindergartners were found to be proficient in language and literacy, 52% in mathematical thinking, and 57% in personal and social development. More than 40% were found to be in the range of "in process" or "not ready." Rates of proficiency were substantially lower for children from low-income families or whose parents had low educational attainment.

Increased attention to the early years of life also has sparked greater interest in the transition to school and the experiences in the early grades that can reinforce preschool learning gains and strengthen school achievement and performance (Bogard & Takanishi, 2005; Reynolds, 2003). Evidence is increasing that school-based programs provide a system that is more likely to contribute long-term benefits for children. Greater interest in kindergarten and early school-age services reflect the importance of policies and practices that enhance the continuity of development. The comparative or added effect of kindergarten programming and early school-age programs and services is of major interest.

Review of Early Childhood Development Programs

In this report, I review evidence on the effectiveness and cost-effectiveness of early childhood development (ECD) programs on school readiness, school achievement and performance, and long-term life course development. The primary focus is on preschool or prekindergarten programs for 3- and 4-year-olds, full-day kindergarten, and early school-age programs including preschool to-third grade programs (PK-3) and practices. Three major questions are addressed.

1. What are the effects and economic benefits of preschool programs?
2. What are the effects and economic benefits of kindergarten and school-age programs?
3. Which elements and principles of effectiveness are key to long-term effects?

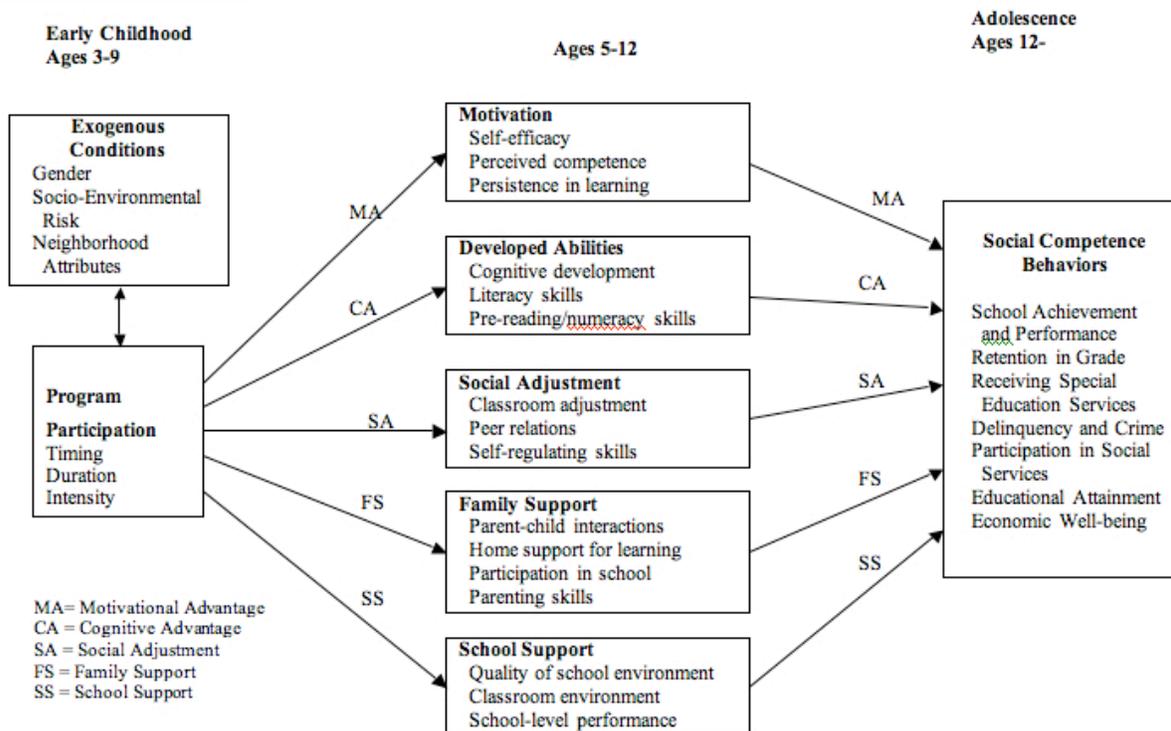
For this review, early childhood development is defined broadly to include the first decade of the children's life. Findings from prenatal and infant programs are beyond the scope of this review, as their family focus differs from the center-based, child development approach of this review.

Although findings on school readiness and achievement are reported in detail, I emphasize cost-benefit analyses of the effects of programs. There are three reasons for the focus on cost-benefit analyses. First, economic benefits relative to costs are the most relevant indicator for policy development. The value of public investments can be judged, at least in part, on efficiency. This is especially true in a time of scarce resources for educational and social programs. Second, in the economic-benefit approach, program effects on multiple outcomes can be converted into the metric of dollars and cents. Other metrics such as standard deviation units or percent change cannot be used across outcomes. Finally, cost-benefit analyses emphasize longer-term effects of programs and practices. A focus on immediate and shorter-term effects while an important first step is neither revealing or unique in evaluation and intervention research. Longer-term effects are a major tenet of early childhood programs. Although preschool and kindergarten programs may have important short-term effects, a major question for social policy is whether these short-term effects translate into long-term effects of adaptive life skills and behavior.

How Early Childhood Development Programs Influence Outcomes

Considerable research has documented that ECD programs impact later school performance and related outcomes through at least one of five processes or pathways (Reynolds, 2000). In short, these can be viewed as the "active" ingredients contributing to impacts of child development. As shown in Figure 1, the first is the cognitive advantage pathway, which indicates that the longer-term effects of ECD programs are due primarily to the enhancement of cognitive skills, including literacy skills, school readiness, and language and numeracy.

Figure 1. Paths from Program Participation to Social Competence Behavior



The family support pathway indicates that impacts on child outcomes derive from greater parental investments in children’s development, such as greater parent involvement in education, increased parenting skills, and greater resource supports for parents.

The school support pathway suggests that longer-term effects would occur to the degree that post-program school experiences reinforce learning gains. Enrollment in higher-quality schools and schools with positive learning environments would strengthen or maintain learning gains while enrollment in schools lower in quality would neutralize earlier learning gains.

The social adjustment and motivational advantage hypotheses indicate that noncognitive skills can be the mechanism of effects of ECD programs, such as increased classroom and peer social skills, positive teacher-child relationships, achievement motivation, and school commitment. The greater the magnitude of effect of program experiences on a particular pathway or multiple pathways, the more likely that enduring effects would occur.

Notably, programs that provide comprehensive services would be expected to impact several of the pathways simultaneously. This is one explanation for why comprehensive programs have been found to be more likely to have longer-term effects.

Cumulative Evidence on Preschool Impacts

Given the voluminous knowledge base, the effects of preschool ECD programs are summarized through findings from 19 reviews of preschool impacts published in the past decade (1995-2006). These reviews were selected as among the most thorough in assessing short- and longer-term effects of both model and large-scale programs (contact the author for additional information). Table 1 includes key characteristics of the reviews such as the number of studies of model, large-scale, and Head Start programs, and the length of follow-ups. The most frequently

cited programs are listed in Table 2 along with the last age of follow-up as of 2006. To be included, the programs had to include a center-based early education or preschool component.

Table 1
Reviews of Early Childhood Intervention Programs (1995-2006)

Review Author	Source	Total	Number of Programs Studies Reviewed			Years Studies Published	Number Studies in Which Effects Reported		
			Large Public Programs	Model Programs	Head Start Programs		Short	Medium	Long
Chambers et al.	Spodeck, ed., <i>Handbook of Res. on the Educ. of Young Children</i> , 2006	12	2	7	3	1968-2001	11 (10)	7 (2)	6 (3)
Blok et al.	<i>International Journal of Behav. Dev.</i> , 2005	17	2	13	2	1985-2001	None	None	None
Karoly et al.	<i>Early Childhood Interventions</i> , 2005	20	6	12	2	1970-2004	20 (17)	3 (2)	5 (5)
Anderson et al.	<i>American Journal of Preventive Med.</i> , 2003	7	1	4	2	1966-1998	7 (6)	5 (4)	4 (4)
Eckenrode et al.	Lerner, ed., <i>Handbook of Applied Dev. Science</i> , 2003	12	5	7	0	1980-2002	12 (12)	5 (5)	5 (5)
Nelson et al.	<i>Prevention & Treatment</i> , 2003	30	7	20	3	1970-2000	27 (27)	13 (13)	10 (10)
Currie	<i>J. Economic Perspectives</i> , 2001	12	1	7	4	1983-2000	10 (8)	4(4)	5(5)
Gorey	<i>School Psychology Quarterly</i> , 2001	12	1	10	1	1978-1998	None	None	None
Brooks-Gunn	<i>Handbook of Early Childhood Int.</i> , 2000	31	5	26	0	1979-1999	31 (30)	0 (0)	1 (1)

Table 1 Cont.
Reviews of Early Childhood Intervention Programs (1995-2006)

Review Author	Source	Total	Number of Programs Studies Reviewed			Years Studies Published	Number Studies in Which Effects Reported		Long
			Large Public Programs	Model Programs	Head Start Programs		Short	Medium	
Farran	<i>Handbook of Early Childhood Int.</i> , 2000	9	3	5	1	1980-1997	9 (9)	4 (4)	2 (2)
Gilliam & Zigler	<i>Early Childhood Research Q.</i> , 2000	12	12	0	0	1977-1999	12 (11)	6 (1)	1 (0)
Halpern	<i>Handbook of Early Childhood Int.</i> , 2000	4	3	1	0	1994-1997	4 (1)	1 (0)	0 (0)
Shonkoff & Phillips, eds.	<i>Neurons to Neighborhoods</i> , 2000	12	1	11	0	1978-1997	12 (10)	4 (4)	4 (4)
Barnett	<i>Early Care and Educ.</i> , 1998	35	6	15	14	1969-1998	19 (13)	22 (18)	10 (6)
Karoly, et al.	<i>Investing in our Children</i> , 1998	10	1	8	1	1970-1997	8 (8)	5 (4)	5 (5)
Bryant & Maxwell	Guralnick, ed., <i>Effectiveness of Early Int.</i> , 1997	12	3	8	1	1977-1994	11 (11)	5 (5)	4 (4)
U.S. General Accounting Office	<i>(GAO/HEHS-97-59) General Accounting Office</i> , 1997	21	0	0	21	1978-1996	21 (18)	2 (1)	0 (0)
St. Pierre et al.	<i>The Future of Children</i> , 1995	5	5	0	0	1982-1995	5 (5)	0 (0)	0 (0)
Yoshikawa	Behrman, ed., <i>Future of Children</i> , 1995	40	1	33	4	1974-1994	37 (32)	10 (10)	4 (3)

Table 2

Most Frequently Cited Early Childhood Education Programs from Research Reviews (1990–2006)

Program	Type	Age	Citations
Avance Family Support and Education	Large Scale	5	3
Carolina Abecedarian Project	Model	21	13
Chicago Child-Parent Centers (CPC)	Large Scale	21	14
Comprehensive Child Development Program (CCDP)	Large Scale	5	8
Consortium for Longitudinal Studies	Model	27	6
Early Training Project	Model	20	8
Educational Testing Service Head Start Study	Large Scale	8	6
Prenatal/ Early Infancy Project (PEIP)/Nurse-Family Partnership Program(NFP)	Model	15	8
Even Start	Large Scale	7	4
Harlem Training Project	Model	12	4
High/Scope Perry Preschool Program	Model	40	19
Houston Parent-Child Development Center (PCDC)	Model	11	12
Infant and Health Development Program	Model	8	11
Institute for Developmental Studies	Model	13	5
Louisville Experiment (Head Start)	Model	16	5
Maryland Head Start	Large Scale	17	4
Milwaukee Project	Model	14	8
New Haven Follow-Through Study	Large Scale	17	6
New York State Experimental Prekindergarten	Large Scale	9	3
Philadelphia Project	Model	18	7
PSID Head Start Longitudinal Study	Large Scale	25	3
Yale Child Welfare Research Project	Model	10	4

Two major conclusions are evident. First, many programs have assessed long-term effects into adulthood. Three quarters of the reviews reported effects at 5 or more years after the end of participation. This is rare for social programs and indicates that impacts on life course development and economic benefits can be accurately assessed. Second, the accumulated evidence includes both model programs, developed for research demonstration, and large-scale programs, developed for routine implementation by schools and other institutions. Consequently, the generalizability of the evidence for policy recommendations is much stronger today than a decade ago.

What are the main findings of the reviews? Of the hundreds of studies synthesized in the reviews, there is substantial evidence that preschool programs for mostly children at risk, positively impact cognitive skills, school achievement, social and emotional development as well as educational attainment, employment, and later social behavior. The average effect size on cognitive skills at or near school entry was 0.42 standard deviations (sd), which is roughly equivalent to one-half of a year of growth associated with preschool participation. Average effects were also statistically and practically significant for social and emotional development (.24 sd), school achievement (.35 sd), delinquency and crime (-.22 sd), grade retention (-.21 sd), special education (-.46 sd), school completion (.27 sd), and employment and earnings (0.37 sd). The breadth of effects suggests positive economic returns.

Effects and Economic Benefits of Three Preschool Programs

Based on their prevention focus and strong evidence of enduring effects, three early childhood programs have had extensive cost-benefit analyses: Carolina Abecedarian Project (ABC), High/Scope Perry Preschool (PPP), and the Child-Parent Center Program (CPC). Table 3 summarizes the three preschool programs and studies. In brief (see Reynolds & Temple, 2006; Temple & Reynolds, 2007 for details), all three programs provided high quality educational enrichment to children at risk in group settings characterized by small class sizes, a focus on language and cognitive skills, and well-qualified and compensated teachers. ABC was the most intensive and lengthy, providing full-day, year round care for five years (Campbell & Ramey, 1995; Ramey, Campbell, & Blair, 1998). PPP provided the most established and organized curriculum, which followed the Piagetian cognitive principle of child-initiated learning (Schweinhart et al., 1993). CPC provides the most comprehensive services by implementing an intensive parent involvement component, outreach services, and attention to health and nutrition (Reynolds, 2000; Reynolds et al., 2002; Sullivan, 1971). It also is the only program that became established in public schools.

A significant difference among programs was child to staff ratios. CPC had 17 children and a certified teacher and aide (8.5 to 1 ratio), which is most consistent with current practice. ABC, implemented in a university-based child care center, had 12 children and two teachers (6 to 1 ratio), neither of whom were certified. PPP had the most unusual structure with 24 children and 4 master's level certified teachers in the classroom for an average ratio of 5.7 to 1. Moreover, unlike the other programs, Perry children were selected because they had IQ scores of 70 to 85.

Table 3

Background and Characteristics of Three Preschool Programs

Characteristic	Perry Preschool	Abecedarian	Child-Parent Centers
Years of operation	1962-1967	1972-1977	1983-1985
City and context	Ypsilanti, MI Urban	Chapel Hill, NC Rural	Chicago, IL Inner city
Location	Elementary school	University center	Elementary school or adjacent to
Number of sites	1	1	24
Child attributes	Low SES IQs of 70-85	Low SES High risk	Low SES Reside in Title I area
Race/ethnicity	100% Black	96% Black	93% Black 7% Hispanic
Entry age	3 years	1-4 months	3 years
Mean duration	1.8 years	5 years	1.6 years
Length of day	Part-day	Full-day	Part-day
Other components	Weekly home visits	Medical services Nutrition	Parent program Outreach Occasional home visits Health services
Mean class size	22	12 (Infancy) 12 (Preschool)	17 12 (Preschool)
Mean child to staff ratio	5.7 to 1	3 to 1 (Infancy)	8.5 to 1 6 to 1 (Preschool)
Curriculum emphasis	Cognitive and social Child-initiated	Language and social Traditional	Language and social Teacher-directed
Staff compensation	Public school	Competitive with public schools	Public school
School-age services	None	K to grade 2	K, grades 1 to 3

Preschool Participation Enhances Children's Well-Being into Adulthood

The major long-term findings of the studies leading to economic benefits are shown in Table 4 (also see Masse & Barnett, 2002; Reynolds et al., 2002; Schweinhart et al; 1993). The estimated impacts of the programs are large and occurred 17 to 25 years after the end of preschool participation. Group differences are specific to preschool participation and are adjusted for child and family background differences between groups such as pre-program IQ, family SES, and other factors.

Table 4: *Adjusted Means or Percentages for Program and Comparison Groups on Key Outcomes for Cost-Benefit Analysis*

Outcome	Perry Preschool	Abecedarian	Child-Parent Centers
Original sample sizes (Program, Control)	58, 65	57, 54	989, 550
Sample recovery for high school completion (%)	94	95	87
Special education services by age 15/18 (%)	15 vs 34	25 vs 48	14 vs 25
Grade retention by age 15 (%)	ns	31 vs 55	23 vs 38
Child maltreatment by age 17	n/a	n/a	7 vs 14
Arrested by age 19	31 vs 51	ns	17 vs 25
Highest grade completed by age 21/27 (mean)	11.9 vs 11.0	12.2 vs 11.6	11.3 vs 10.9
High school completion by age 21/27 (%)	71 vs 54	70 vs 67 (graduation)	66 vs 54
Attend college by age 21/27 (%)	33 vs 28	36 vs 14 (4-year)	24 vs 18
Employed at age 21/27 (%)	71 vs 59	70 vs 58 (teen mothers)	n/a
Monthly earnings at age 27 (\$)	1219 vs 766	n/a	n/a

Note. For Perry, special education is for EMI placement by age 15. Ages for educational attainment and employment are 27 for Perry, 21 for Abecedarian, and 22 for Chicago. ns = not significant; n/a = not available

Although the magnitude of estimated effects varied, participation in all three programs was associated with significantly lower rates of special education services up to and including adolescence. The impact on special education was large, as preschool participants had rates of special education that were 40-60% lower than the comparison group. Similar reductions in grade retention were observed for ABC and CPC programs. The Consortium for Longitudinal Studies (1983) showed similar results.

Participation in each program also was linked to significantly higher rates of high school completion up to age 27 as well as more years of education. Preschool participation was associated with about a one-half (CPC and ABC) to full year increase (PPP) in educational attainment. Program participants also had higher rates of postsecondary and college attendance, with ABC showing large differences in attendance at 4-year colleges.

On employment and earnings, only PPP has shown significant group differences but this may reflect the age at follow up assessment (27 versus 21/22 for the ABC and CPC). For ABC, differences in employment were largest for teen mothers of program participants. Employment and earnings are not currently available for CPC.

Finally, both PPP and CPC have demonstrated significant program effects on crime. These effects are large. Participation in PPP was associated with a 40% decrease in arrests by age 19 (from 51% to 31% ever arrested) whereas CPC was associated with a 33% reduction in juvenile petitions by age 18 (from 25% to 17% with 1 or more petitions). Only PPP has collected data on adult crime, and findings are consistent with those of earlier ages. The lack of crime prevention benefits in ABC may be due to the low base rates of crime in Chapel Hill, North Carolina or, more likely, to the relative absence of family services in the program. Overall, these findings show that the programs enhanced participants' general social competence over the first two decades of life.

Not shown are the substantial effect sizes for program participation on cognitive skills at the time of kindergarten entry, and on school achievement through the elementary grades. CPC participation also was associated with higher levels of parent involvement in school.

Summary of Results of Cost-Benefit Analyses

At a minimum, the economic return should equal the amount invested in the program--a return of at least one dollar per dollar invested. Estimates of economic benefits derive from three sources. Benefits to participants are returned to the child and parent attending the program but do not directly benefit others in society. These benefits include increased earnings capacity in adulthood projected from educational attainment as well as the benefit to parents from the provision of part-day care for children. Benefits to the general public include averted expenditures of remedial education and social welfare spending by governments, reduced tangible expenditures to crime victims as a result of lower rates of crime, and increased tax revenues to state and federal governments as a result of higher earnings capacity. Benefits to society at large include the sum of benefits to program participants and to the general public. Societal benefits are emphasized, which represent the total economic contribution of programs (Footnote 1).

As shown in Table 5, all three programs showed substantial economic returns of preschool into adulthood through government savings in education, justice system, and health expenditures and in increased economic well-being. The values are those reported in the CBAs for each program. All values are the average economic return per program participant in 2002 dollars. The assumptions underlying each CBA were not identical.

Table 5*Summary of Costs and Benefits Per Participant in 2002 Dollars for Three Preschool Programs*

Costs and Benefits	High/Scope Perry Preschool	Chicago Child-Parent Centers	Abecedarian Project
Program Costs (\$)			
Average program participant	15,844	7,384	35,864
For one year of participation	9,759	4,856	13,900
Program Benefits (\$)			
Total benefits	138,486	74,981	135,546
Net benefits (benefits-costs)	122,642	67,595	99,682
Total benefit per dollar invested	8.74	10.15	3.78
Public benefit per dollar invested (Benefit-cost ratio)	7.16	6.87	2.69

Note. Costs are program expenditures and do not include estimated costs for comparison-group experiences. Ages of study participants for economic analyses were 27, 21, and 22, respectively. The Abecedarian cost is relative to control group. The total cost per participant was \$67,225. Based on the actual costs, total and public benefits of Abecedarian Project per dollar invested are \$2.02 and \$1.44, respectively.

Although the costs of the programs are significantly different from each other, the economic returns of each program far exceeded the initial investment. The total economic benefits per participant, both measured and projected over the life course, ranged from \$74,981 to \$138,486. The net economic benefit per participant (benefits minus costs) for Perry was \$122,642 and for Abecedarian was \$99,682. The net economic benefit for the Child-Parent Centers, an established Title I program, was \$67,595. The benefit for ABC is especially salient given its relatively high cost. Despite the cost of full-day year-round care for five years, the program returned per participant nearly \$100,000. Indeed, using the actual cost of ABC (\$67,225) rather than the marginal cost (actual cost minus the costs of care for the comparison group) benefits substantially exceeded costs.

Table 5 also shows the economic benefits as a ratio of program costs. These ratios can be interpreted as the economic return per dollar invested, which is an indication of program efficiency. Benefit to cost ratios index the return on investment, whereby \$2 dollars per dollar invested would be a 100% return. All three programs showed a large return on investment based on data collected into adulthood, ranging from a total societal benefit of \$4 per dollar invested to \$10.15 per dollar invested. These are equivalent to a 278% to 915% return on the dollar. The CPC program showed the highest benefit-cost ratio, reflected its relatively lower costs. The lower costs are primarily a result of a higher child to staff ratio in the classroom (8.5 to 1 versus less than 6 to 1 for Perry and Abecedarian). That a routinely implemented school-based program demonstrates positive returns is encouraging. The other school-based program, Perry Preschool, demonstrated an economic return of \$8.74 per dollar invested. At \$3.78 per dollar invested, ABC had the lowest benefit-cost ratio. This is not surprising given its high cost. In terms of public benefits alone (i.e., government and crime victim savings), benefit-cost ratios ranged from \$2.69 to \$7.16 per dollar invested.

In summary, the CBA findings show the high returns of investments in preschool education despite the differences in timing, duration, geography, time period, and content of the three programs. This consistent pattern of results strengthens the generalizability of findings to contemporary programs.

Effects of Contemporary State-Financed Preschool Programs

The consistent findings of the economic analyses of the Perry, Chicago, and Abecedarian programs despite their major differences in social context and instructional approach are encouraging evidence in favor of expanding preschool access. Nevertheless, the participants of the three programs were almost exclusively low-income, African American children. While there is no comparable evidence from studies of middle income families or from more diverse samples, research on the short term effects of state-funded preschool programs, which include more diverse samples by socioeconomic status and race/ethnicity, provide an indication of the extent to which the findings could provide a similar pattern of effects. Because intensive programs achieve their long-term effects initially from enhancing school readiness skills and because studies of current state-funded programs lack information on longer-term effects, I compare the estimated effect sizes on school readiness between intensive preschool programs with those more routinely implemented state-funded programs (e.g., Gilliam & Zigler, 2001).

Findings are reported in Table 6. For consistency, the impacts are reported in standard deviation units whereby a value of .20 or above is considered an educational meaningful difference in favor of program participants. Gilliam and Zigler (2001) assessed the impact of state-funded preschool on school readiness in preschool and kindergarten up to 998 in six states and the District of Columbia. Although the programs primarily served children at risk, participants were more heterogeneous on family income and race and ethnicity than those of intensive programs. They reported an average effect size of .36 standard deviations.

Table 6

Effect Sizes for State-Funded and Intensive Preschool Programs on School Readiness (Values are Standard Deviation Units)

Program/Study	Urbanicity/ N of sites	SES attributes	Language-cognitive skills at age 5
State-Funded Preschool			
Gilliam & Zigler, 2001	Mixed	Lower income 7 states and cities	.36
Hustedt et al. 2007	Mixed New Mexico	Lower/Middle	.37
Hustedt et al. 2007	Mixed Arkansas	Lower/Middle	.30
Frede et al. 2007	Urban New Jersey	Lower income	.32
Barnett et al. 2006	Mixed Oklahoma	Lower/Middle	.26
Gormley et al. 2005	Urban Tulsa, OK	All SES	.58
Intensive Preschools			
CPC/Perry Preschool/ Abecedarian Mean	Mixed 22 sites	Low income	.66
Consortium for Longitudinal Studies (1983)	Mixed 13 sites	Low income	.50

Note. Language-cognitive skills was measured by one of following: IQ tests (only Perry, Abecedarian, and Consortium), cognitive, vocabulary/language skills, literacy, or early academic achievement. Age of assessments vary between end of preschool and beginning of kindergarten. Most of state-funded programs were average of receptive vocabulary and math skills.

Effects sizes for evaluations of state-funded programs for 4-year-olds implemented from 2002 to 2006 in New Mexico, Arkansas, New Jersey, and Oklahoma ranged from .26 to .58. These are statistically and educationally meaningful. Note that the effect sizes for language/vocabulary and math skills are averaged, as the assessments were identical across states. The strong effect size for the Tulsa was for the universal Oklahoma prekindergarten program (Gormley et al., 2005) that served children from all SES backgrounds.

While findings are generally limited to short-term effects, recent studies show benefits at the end of kindergarten and beyond for state-funded programs (Frede et al., 2007; Schweinhart, 2002) and for other large-scale programs (see Table 1).

In summary, findings of the evaluations consistently show positive and meaningful effects in many states for both universal and targeted programs. However, effects sizes are smaller than for intensive preschool programs but the reach of the state-funded programs is greater.

Cost-Benefit Analyses from Policy Simulations

To estimate the economic benefits of high-quality but routinely implemented preschool programs, several researchers have conducted cost-benefit simulations that either modify assumptions of actual the cost-benefit analyses of longitudinal analyses of model programs or make projections from correlational data linking short-term outcomes such as achievement scores to educational attainment, income and criminal behavior, which are more easily translated to economic benefits. Three such analyses are summarized below. All indicate that more widely implemented preschool programs for 3- and 4-year olds would be likely to yield benefits than significantly exceed costs.

Using short- and long-term data from 58 evaluation studies published from 1967 to 2003, Aos et al. (2004) estimated an economic return of \$2.36 return per dollar invested for preschool programs for low-income 3- and 4-year-olds. In 2003 dollars, the estimated cost per child was \$7,301 (which was based on the CPC program) and societal benefits of \$17,202. It should be noted that the estimates were based on studies that investigated long-term outcomes such as educational attainment and studies limited to short-term outcomes such as achievement, which were used to make long-term projections. Moreover, while many categories were included in benefit estimates, intangible crime victim savings, mental health outcomes, health insurance, or potential intergenerational effects were not included.

Karoly and Bigelow (2005) estimated the economic benefits of universal access to one year of preschool education at age 4 in California. Based in part on cost-benefit findings from the CPC program and assuming a 70% participation rate, the estimated return to California society at large was \$2.62 per dollar invested. The most conservative estimates were about \$2 return per dollar invested and the most liberal were about a \$4 return per dollar invested. To the extent that intangible crime victim savings, child welfare savings associated with reduced child maltreatment, improvements in health and well-being, and intergenerational effects are included, cost-effectiveness estimates would be significantly higher.

A broader national analysis by Lynch (2007) used modified estimates from the cost-benefit analysis of the CPC program (Reynolds et al., 2002) to generalize across states and in the country at large. It was estimated that by the year 2050, a high quality targeted preschool program for 3- and 4-year-olds would cost \$5,700 (2002 dollars) per child and provide a return per tax dollar invested of \$3.18 in government budget savings alone. For a universal access program, the return per tax dollar invested was estimated at \$2.00 for government budget

savings. Considering all societal benefits (budget savings, justice system and child welfare savings, and increased earnings), the long-range annual benefit per tax dollar invested was estimated at \$12.10 for a targeted program and \$8.20 for a universal access program.

The Effects of Full-Day Kindergarten

Although there are no cost-benefit studies of the effect of full-day kindergarten (FDK) over half-day kindergarten, many studies have examining achievement gains at the end of kindergarten and in the early school grades. Aos et al. (2007) synthesized the results of 23 well-designed comparison-group studies of the effects of FDK on academic achievement and related outcomes. The average effect size of FDK on achievement at the end of kindergarten was .18 standard deviations for all children and .17 for economically disadvantaged children. This is equivalent to roughly a 2-month increase in achievement. This relatively small advantage largely disappeared by first grade and did not re-emerge later. The average effect size was .01 at the end of first grade, .048 at second to third grade, and .00 at fourth and fifth grade. These findings include analyses of the Early Childhood Longitudinal Study, which tracks a national sample of 20,000 kindergartners from 1998 (Le, Kirby et al., 2006). Aos et al. (2007) reported that the net annual cost per child (2006 dollars) for implementing FDK is \$2,611 in Washington State. This cost would be expected to vary by state. Based on the available evidence, the benefit-cost ratio of FDK relative to half-day kindergarten is approximately zero. Assuming no other benefits are achieved, the economic return is likely to be negative.

Table 7

Effects of Full-Day Kindergarten (FDK) and Half-Day Kindergarten (HDK) in the Chicago Longitudinal Study of the Child-Parent Centers on Reading Achievement

Program participation	ITBS achievement standard score			Gain in K	Gain K to 1
	Start of K	End of K	End of Gr. 1		
One year of Preschool and FDK	47.3	64.9	73.9	17.6*	8.9
One year of Preschool and HDK	47.5	61.8	75.4	14.3	13.6**
No preschool and FDK	44.1	59.9	69.7	15.8	9.8

Note. Sample sizes for 1-year HDK participants, 1-year FDK participants, and the no-preschool FDK comparison group were 273, 182, and 550. Group attrition rates were no more than 10% by the end of first grade.

*Gain score is significantly greater than HDK group.

**Gain score is significantly greater than CPC group in FDK.

To illustrate the common finding on FDK, Table 7 shows mean reading achievement test scores for children in the Chicago Longitudinal Study of the Child-Parent Centers. As shown, the impact of FDK relative to HDK is small and short-lived. As shown, for both children with and without prior CPC preschool, FDK enrollment was associated with greater gains during kindergarten on word analysis subscale of the Iowa Tests of Basic Skills. At the end of first grade however, FDK was not associated with reading achievement test scores or learning gains since kindergarten. FDK participants with no preschool experience had significantly lower reading scores than both preschool groups. This pattern of findings was similar for children who had two years of preschool and for the outcome of math achievement. Similarly, Clements, Reynolds, and Hickey (2004) found that FDK was associated with higher reading achievement in kindergarten but not in math or socio-emotional outcomes.

While more studies of the long-term effects of full-day kindergarten are needed across academic and social outcomes, given the meager short-term findings found in most studies, it is unlikely long-term effects would emerge. This is partly due to later timing of services, the lack of comprehensive services, and the diminishing return of additional services beyond half-day programming.

Class Size Reductions

In a recent synthesis of 38 studies of class size reductions, Aos et al., (2007) reported that reducing class sizes in kindergarten through second grade was more cost-effective than reducing class sizes in third through sixth grades, middle school, or in high school. For each additional student classes are reduced, the effect size on achievement increases by .019 standard deviations for kindergarten to second grade and by .007 standard deviations for third to sixth grades. These are relatively small effects. A reduction from 25 to 15 students in kindergarten, for example, increases achievement by .19 standard deviations. This one-fifth of a standard deviation improvement (2-3 month gain in learning) also was found in the Wisconsin SAGE program for 3,000 kindergarten and first graders in 30 schools (Molnar et al., 1999). The corresponding increase in achievement is .07 standard deviations for small classes in grades 3 to 6.

Based primarily on the higher test scores of students in smaller classes, the Aos et al. estimated that the economic return of small classes in kindergarten through second grade was \$2.79 per dollar invested and \$1.38 for small classes in third through sixth grades. Given the absence of effects, cost-effectiveness for small classes in later grades was not estimated.

In the most extensive study of class size reduction, Project STAR in Tennessee experimentally investigated the impact of enrollment in class sizes limited to 13 to 17 students from kindergarten to third grade relative to enrollment in class sizes of 22 to 26 students with and without teacher aides. A total of over 6,300 kindergarten students in 79 schools and 46 districts were included. Although one or more years of enrollment in reduced class sizes was associated with higher achievement test scores in the short-term, longer-term effects by eighth grade were found only for students with three or four years of reduced class sizes (Finn et al.,

2001). The three-year group had median effect sizes of .13 to .21 standard deviations in grades 4 to 8. The four-year group had median effects sizes of .21 to .29, which represents at least one half a year of growth by eighth grade. One year of reduced class size had no long-term effects and two years had small effects of about .10 standard deviations. Minority children and those from low-income families experienced more positive effects. Relative to control groups, only low-income students with 3 or 4 years of small classes had higher rates of high school graduation (Finn et al., 2005).

Based on Krueger (2003), Project STAR was found to have an economic return of \$2.83 per dollar invested in the program. The source of this benefit is an increase of 0.2 standard deviations in test scores, which is associated with a 1.6% increase in adult earnings. The average economic benefits per participant were \$23,913 (2002 dollars) and an average cost per participant of \$8,454 for 2.3 years of small classes (Krueger, 2003).

Additional evidence on small class sizes comes from the school-age program of the Child-Parent Centers, of which the main program element was a reduction in class sizes from 35 to 1 to 25 to 2 (teacher and aide) during grades 1 to 3. The school age program also included instructional resources to promote reading and math achievement and family support activities under the direction of a program coordinator. School-age participation was independently associated with significantly higher levels of reading achievement, and with lower rates of grade retention and special education placement. The economic return for two years of school-age intervention was \$2.12 per dollar invested (Reynolds et al., 2002). While this return per dollar invested is much lower than that of the CPC preschool program, it is within the range of that found for Tennessee STAR.

Other School-Age Programs and Practices

Given their implications for cost-effectiveness, two additional ECD programs are covered. The Skills, Opportunities and Recognition (SOAR) Program, formerly the Seattle Social Development Project, is designed to promote social and emotional skills (Hawkins et al., 1999). Starting in grade 1 and continuing to grade 6, the supplemental classroom-based program includes cooperative, developmentally-appropriate teaching practices and optional parent education classes. Six years after the end of the program, participants had greater attachment to school, higher achievement test scores, and lower rates of delinquency, and lower rates of alcohol misuse. With an average program cost of \$4,712 per student, estimated economic benefits to society are \$14,810 for a return of \$3.14 per dollar invested (Aos et al., 2004; Small et al., 2004).

Reading Recovery is an instructional tutoring program for first-grade students who are having difficulty learning to read. The program provides 30 minutes of one-on-one daily instruction with a teacher outside of the regular school class. Students in the bottom 20% in reading performance are enrolled in the program. In more than 30 studies that have been conducted of Reading Recovery (D'Agostino & Murphy, 2004), findings are generally consistent that the program significantly increases participants reading performance and helps close the gap

with more typically performing students (D'Agostino & Murphy, 2004; Shanahan & Barr, 1995). Effect sizes at the end of intervention average about .75 standard deviations. These drop to under .15 standard deviations by third or fourth grade, however.

Reading recovery is a relatively expensive program. In 2002 dollar, the average cost per child was estimated at \$4,830 (Shanahan & Barr, 1995). Although formal cost-benefit analyses have not been reported, Shanahan and Barr (1995) estimated that the program would, at best, be expected to recover about 30% of its costs through reductions in special education placement as a consequence of the short-term achievement effects. This would be a return of \$0.30 per dollar invested. To the extent that achievement gains would endure, this may be an underestimate.

Preschool-to-Third Grade Programs

A key rationale for transition programs and practices in the early school-age years is that elementary schools play an important role in sustaining the benefits of early childhood programs, and a continuation of programs into the primary grades will promote successful transitions. Preschool-to-third grade (PK-3) programs are the most comprehensive approaches for enhancing transitions and promoting positive child development. Several extended early childhood programs have provided preschool and school-age services to children and families at risk due to economic disadvantage.

The core attributes of PK-3 programs have become evident in recent years as empirical knowledge is established (Bogard & Takanishi, 2005; Reynolds, 2003). Four key principles are critical. These are programs and practices that (a) support continuity, (b) enhance capacity for organization of services, (c) promote instructional practices, and (d) encourage family support behavior and school-family partnerships. To the extent that P-3 programs and practices contribute to the principles, positive impacts on child development are expected. Studies have indicated that the quality and duration of developmentally appropriate early childhood experiences are strongly linked to later school performance and adjustment in adulthood (Campbell et al., 2002; Reynolds, 2004). While research supports the efficacy of early intervention, the "fade-out" phenomenon has been linked to enrollment in lower quality schools.

The four best known programs are described below. Table 8 shows their key features.

Table 8*Cost-Effectiveness Estimates for Early Childhood Programs, Preschool to Third Grade*

Developmental Stage	Focus	Location	2002 Dollars			Ratio
			Benefits	Costs	B-C	
Preschool						
Child-Parent Centers	Targeted	20 Chicago sites	72,000	7,324	67,444	10.15
Perry Preschool	Targeted	1 Ypsilanti site	125,000			8.74
Abecedarian Project	Targeted	1 NC site	135,546	67,225	68,321	2.02
RAND study of Preschool in CA	Universal	State of CA	11,375	4,339	7,036	2.62
National PreK synthesis for 2050 (Lynch, 2007)	Targeted	National	18,126	5,700	12,426	3.18
	Universal	National	11,400	5,700	5,700	2.00
Synthesis study Aos et al. (2004)	Targeted	58 programs	17,202	7,301	9,901	2.36
Kindergarten						
Full-Day K* synthesis	Universal	23 programs	close to 0	2,343	Negative	< 0
School-Age						
Tennessee STAR Small classes	Universal	79 schools	23,913	8,454	15,459	2.83
K-2 synthesis of small classes	Universal	23 studies				
Grade 3-6 synthesis of small classes	Universal	23 studies				
CPC school-age	Targeted	20 sites				

Table 8 (cont.)*Cost-Effectiveness Estimates for Early Childhood Programs, Preschool to Third Grade*

Developmental Stage	Focus	Location	2002 Dollars			Ratio
			Benefits	Costs	B-C	
Reading Recovery*	Targeted First graders	General	1,610	4,830		0.30
Skills, Opportunities, and Recognition	Universal	Seattle schools	14,810	4,712		3.14
PK-3 Intervention Child-Parent Centers	Targeted	20 sites				

Note. Estimates for Lynch's (2007) were the most conservative. Total benefits relative to costs were \$12.10 and \$8.20 for targeted and universal programs. Using the relative program cost for the Abecedarian Project, the ratio of benefits to costs was \$3.78. Full-day kindergarten cost is relative to half-day kindergarten in Washington State (Aos et al., 2007) and is converted to 2002 dollars.

*Estimates are not based on formal cost-benefit analyses.

Carolina Abecedarian Project

The Carolina Abecedarian Project (ABC) served low-income minority children at high risk for cognitive delays or academic problems. Program-group children received five years of enriched educational day care from age 4 months to 5 years (prior to kindergarten) followed by a school-age intervention for three years through second grade. A systematic curriculum, including learning activities in the cognitive, language, and social emotional development, was used. The school-age intervention used a family-support model, and also supported children's academic development through increasing and enhancing parent involvement in the educational process (Campbell & Ramey, 1995). A Home School Resource Teacher offered learning activities and provided materials for mothers to use at home with their children (Campbell, Helms, Sparling & Ramey, 1998). These teachers were home/school liaisons on behalf of the student, and provided community outreach. In addition, the school-age program included a six-week summer transition program prior to kindergarten entry. ABC was implemented at a single site for yearly cohorts from 1972 through 1977. Of the total sample of 111 children, 25 participated in the PK-3 program through second grade.

Research Findings. Evaluations have consistently showed that the 5-year preschool program produced greater intellectual and academic outcomes than does the 3-year school-age program. Nevertheless, an additional dosage-response effect has been found for children who participate in both preschool and school-age programs. These children have the highest levels of intellectual and scholastic performance at the end of the program at age 8; and the extended intervention group surpassed the performance of the preschool-only group by one-third of a standard deviation (Campbell & Ramey, 1995). At the age 15 follow-up, the extended group surpassed the nonextended group only for reading achievement (Ramey, Campbell, Burchinal, Skinner, Gardner, & Ramey, 2000). Although this trend was apparent at the age 21 follow-up, the difference was not statistically significant (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002).

Head Start/Follow Through (FT)

The Head Start/Follow Through (FT) programs tested the effects of alternative instructional methods on children's educational development in kindergarten to third-grade classrooms. It was implemented as a series of "planned variations" of five instructional models and mixtures including (a) Parent Education Model, (b) Direct Instruction Model, (c) Behavioral Analysis Model, (d) High/Scope Cognitively Oriented Curriculum Model, and (e) the Bank Street Model of Developmental-Interaction. Like Head Start, FT Programs included health and social service components, home visits from paraprofessionals who encouraged parents' participation in their child's education, and participation in school advisory councils.

Research Findings. A national evaluation showed that substantial modifications in the classroom learning environment in kindergarten and the early primary grades can enhance children's early educational success as well as social and emotional development, thus improving the transition to school. However, the instructional models were not equally effective in promoting student achievement. The Direct Instruction and Behavioral Analysis models were most consistently associated with higher achievement test scores. Studies based on the High Scope, Bank Street, and Direct Instruction models found that Head Start with FT was associated with higher school achievement in the short-term, but these effects were reduced over time (Seitz, Apfel, Rosenbaum, & Zigler, 1983).

Chicago Child-Parent Center and Expansion Program (CPC)

The Chicago Child-Parent Center (CPC) and Expansion Program was developed to promote academic success among low-income children. The CPC program was established in 1967 through funding from Title I of the Elementary and Secondary Education Act. The program includes three components: a child-centered focus on the development of reading/language skills, parental involvement, and comprehensive services (Reynolds, 2000).

CPC included a half-day preschool program for three- and four-year-olds, a half-day or an all day kindergarten program, and 2 or 3 years of school-age intervention in co-located

elementary schools. The center operates on the nine-month school year calendar. An eight-week summer program is also provided. Parents were expected to involve in the center at least one half-day per week. The comprehensive services include (a) attending to children's nutritional and health needs (i.e., free breakfasts and lunches and health screening), (b) coordinated adult supervision, including a CPC head teacher, parent resource teacher, school-community representative, and a teacher aide for each class, (c) funds for centralized in-service teacher training in child development as well as instructional supplies, and (d) emphasis on reading readiness through reduced class size, reading and writing activities in the learning center, and reinforcement and feedback.

The expansion or school-age program continued to provide parents with a parent resource room, a community representative, and encouraged parent involvement. The program was designed to enrich the primary-grade classroom experience. In each grade, class sizes were reduced to a maximum of 25 children and each teacher was provided with a teacher aide. Like the Head Teacher, the Curriculum Parent Resource Teacher provides in-service training to classroom teachers and aides in the expansion classrooms.

Research Findings. Participation in the CPC Program has been found to be significantly associated with higher levels of academic achievement and parent involvement in children's education (Reynolds, 2000). Children participating in the preschool plus follow-on services were found to have higher academic achievement when compared with children receiving only the preschool or follow-on programs (Conrad & Eash, 1983). Children with extended program participation (4 or more years of services) had higher achievement in the eighth grade and better high school graduation rates than children with no intervention (Fuerst & Fuerst, 1993). In addition, CPC participation through second grade was associated with a seven-month advantage in reading and math achievement, lower rates of grade retention, and lower rates of special education placement (Reynolds, 1994). Students participating through the third grade fared even better, and the benefits persisted up to age 15. Extended program participation was also associated with lower rates of school remedial services (grade retention by age 15 and special education placement by age 18), and with lower rates of delinquency infractions (Reynolds, Temple, Robertson, & Mann, 2002). At the age 24 follow-up, extended program participation was associated with higher rates of high school completion and full-time employment, and lower rates of Medicaid receipt and violent arrest (Reynolds, Temple, Ou, Robertson, Mersky & Topitzes, 2005).

National Head Start/Public School Early Childhood Transition Demonstration Project

HST tested the value of extending comprehensive, Head Start-like supports through the first four years of elementary school. This program provides a range of Head Start-like family services to assist in the transition from Head Start to public schools, help families with health issues, and improve children's school performance. A total of 7,515 former Head Start children and families were recruited at 31 sites to participate in the National Study in 1992/93 and 1993/94. Approximately 12,000 children participated, however, since supports and educational

enhancements were offered to all children and families in the classrooms. Program enrollment was based on random assignment of schools to a Transition Demonstration group. There were differences across sites in whether schools or school districts were randomly assigned.

There are 4 key features of the HST program (Ramey, Ramey, Phillips, Lanzi, Brezausek, Katholi et al., 2000). First, families participating in the HST were encouraged to participate in their children's schooling, and were provided with a number of educational resources. Second is educational enhancement, especially to promote use of developmentally appropriate curricula and practices and continuity in children's educational experiences. Third, family social support services were provided to help facilitate positive family-school interactions and to assist in securing and coordinating services across agencies. Finally, health and nutrition services and activities were provided to ensure the physical and mental health of the entire family. Most local sites had plans for promoting the inclusion of children with disabilities, addressing cultural and linguistic diversity, and developing individualized transition plans for each child.

Research Findings. To date, evaluations of HST indicated no overall effect (Ramey, Ramey, & Lanzi, 2004). There is no difference on academic achievement or social development between children in the HST schools and children in the control groups. This was attributed to the implementations of the programs. Only about 20% of the sites implemented very strong programs. Moreover, many comparison schools adopted these features and supported through other resources or funding.

Nevertheless, the findings indicate these former Head Start children entered school below other children nationally, but they showed significant gains in reading and math in early elementary school, and quickly rise to perform close to the national averages by third grade. Furthermore, HST participants demonstrated typical levels of growth in social skills and were rated by their teachers and parents as socially and behaviorally well adjusted to school. The majority of HST children also reported positive experiences at schools (Ramey et al., 2000). One study found that participation in the HST was associated with lower rates of mental retardation and emotional disturbance, but an opposite effect was found in the category of speech or language impairment (Redden, Forness, Ramey, Ramey, Brezausek & Kavale, 2001).

Cost-Benefit Analyses of Preschool-to-Third Grade Programs

Only the CPC extended intervention program has been the subject of cost-benefit analysis. Compared to participation in less extensive CPC services (0 to 3 years of intervention), the CPC extended program returned \$9.05 per dollar invested through reduced remedial education and child maltreatment, lower juvenile arrest for violence, and higher levels of educational attainment. Exclusive of intangible crime victim savings, the return was \$6.11 per dollar invested.

The school-age program alone demonstrated a return of \$2.12 per dollar invested primarily through participants requiring fewer remedial education services (Reynolds et al., 2002). The return per dollar invested was \$1.66 without intangible crime victim savings. The

main components of the school-age services were reduced class sizes, family services, and instructional support to classrooms.

Characteristics of Effective Programs

The evidence described in this section shows that extended early childhood programs can promote more successful transitions to school than preschool interventions alone. Although more longitudinal data are needed, several characteristics of successful programs can be drawn from this review. First, programs that focus on language-based school readiness skills appear to be more beneficial to children. Second, multiple years of services are associated with successful transition to schools. Third, using schools as the single delivery system for early and extended childhood interventions can strengthen the continuity of services to children and avoid the disjointedness between preschool and school-age programs. Fourth, it is important for programs to have an intensive family support component that facilitates parental involvement and commitment to the child's education, and promote parents' personal growth. Finally, it is beneficial to children to add teacher aides in the classroom to reduce class sizes and student-teacher ratios so that children can receive individualized attention and more individual learning opportunities. Programs should be tailored to the needs of children across the entire first decade of life. As many children are now entering schools at a higher risk than students entering 10 years ago, continuous services across the first decade of children's lives provide the optimal level of support for their learning and development and does not presume that intervention at any stage of development (infancy, preschool, school-age) alone can prevent children from future underachievement.

Summary of Cost-Effectiveness

Table 8 summarizes the economic returns of ECD programs from preschool to third grade. Preschool for 4-year-olds has demonstrated the highest returns across many programs in different contexts, decades, service systems, and curricular philosophy. New evidence from state PreK programs show positive effects on school readiness.

Small classes in the early grades show positive returns from test score gains (Krueger, 2003) but long-term effects were limited to low-income children with 3 or 4 years of enrollment (Finn et al., 2005). Substantial reductions in class sizes (i.e., 25 to 15) are needed to meaningfully improve achievement (Aos et al., 2007).

The CPC PK-3 intervention shows substantial benefits above and beyond earlier intervention. The SOAR social-skills program also has demonstrated positive long-term effects leading to cost-effectiveness. Neither Reading Recovery or full-day kindergarten have findings suggestive of cost-effectiveness. Across many studies, the average effect of full-day kindergarten is not detectable after the end of kindergarten.

Cost-effectiveness is one of many criteria for prioritizing investments. Social importance, feasibility, and capacity for sustainability also are important to consider in policy making.

Key Principles of Effectiveness of Early Childhood Development Programs

Findings summarized in this review indicate that greater investments in high-quality preschool and school transition programs are warranted. Since nearly two in five children do not enroll in center based preschool programs, and the quality of services that many receive is not high, the ECD programs summarized in the review provide effective models to be used in the design of coordinated early childhood systems. Research on these three programs and on many other programs suggest five major principles that can enhance the effectiveness of early childhood development programs and to increase long-term economic benefits.

The first main principle is that a coordinated system of early education is in place beginning at age 3 and continuing to the early school grades. Program implementation within a single administrative system in partnerships with communities can promote stability in children's learning environment which can provide smooth transitions from preschool to kindergarten and from kindergarten to the early grades. The three major programs we reviewed were either housed in elementary schools or provided continuity of services between preschool and formal schooling. This is a "first decade" strategy of promoting child development. Today, most preschool programs are not integrated within public schools and children usually change schools more than once by the early grades. In the movement to universal access to early education, schools could take a leadership role in partnership with community agencies. More generally, programs that provide coordinated or "wrap-around" services may be more effective under a centralized leadership structure rather than under a case-management framework. The CPC program, for example, is an established program in the third largest school system in the nation. Findings from the cost-benefit analysis of a complete cohort CPC participants gives a good indication of the size of effects that could be possible in public schools, the largest administrative system of any universal access program.

Among the recommendations that are consistent with this principle of system coordination are (a) to increase the amount of Title I funds that go to preschool. Less than 5% of the \$13 billion annually allocated to schools under Title I goes to preschool; (b) to increase the number of Head Start programs administered by public schools. Only about one-third of Head Start grantees are schools; and (c) to expand the availability of full-day preschool programs and transition programs to promote early school success. Research in the CPC and Abecedarian programs indicate that as program length increases, so does children's school performance.

A second major principle of effective ECD programs is that the teaching staff should be trained and compensated well, preferably with earned bachelor's degrees, certification in early childhood, and competitive salaries. These characteristics are much more likely under a public school model of universal access, notwithstanding the need for established partnerships with community child-care agencies. It is no coincidence that the three major programs reviewed in the chapter followed this principle. Being located in public schools, the Perry and CPC programs were implemented by teachers with at least bachelor's degrees and appropriate certification in early childhood. They were paid on the public school salary scale, and Perry teachers received a 10% bonus for working in the program. In the Abecedarian program,

teachers were compensated at level that was highly competitive with public schools. Turnover was low in all three programs. In most other early education programs, from child care to Head Start, staff do not have this level of education, training, and compensation, and turnover significantly higher.

Third, educational content should be responsive to all of children's learning needs but special emphasis should be given to cognitive and school readiness skills through a structured but diverse set of learning activities. All of the cost-effective programs reviewed had a strong emphasis on the development of cognitive and language skills necessary to do well in school within a responsive learning environment. Child to staff ratios of less than 9 to 1 in preschool help as well. The curriculum appeared to less important since the programs spanned from Perry's child-initiated approach to Chicago's blended, teacher-directed approach. Extrapolating these findings, preschool and other social programs are more likely to have enduring effects if they provide services that are intensive and are dedicated to the enhancement of educational and social skills.

A fourth principle of effectiveness is that comprehensive family services should be provided to meet the different needs of children. As child development programs, preschool, kindergarten, and school-age programs must be tailored to family circumstances and thus provide opportunities for positive learning experiences in school and at home. Those with special needs or who are most at risk benefit from intensive and comprehensive services. Each of the cost-effective preschool programs discussed in the chapter provided family services. Abecedarian provided medical and nutritional services. The Perry preschool had weekly home visits by teachers. In the CPC program, parent involvement is more intensive as each center has a parent resource room run by a certified teacher and provides school-community outreach. Parents' own educational and personal development are important program goals.

Finally, greater commitment to on-going evaluations of effectiveness and cost-effectiveness is needed. Even today, cost-benefit analyses are rarely conducted. This state of affairs limits full consideration of the effects of alternative programs. Paramount in conducting cost-benefit analyses is the availability of longitudinal studies of programs for children and youth. These studies are more likely to accurately assess the total impact of program participation. In addition, more studies are needed that address the differential effects of participation across a range of child, family, and program attributes. The identification of the processes of effects or "active ingredients" that promote enduring effects also is a high priority.

Policy Recommendations

1. Establish a state-funded prekindergarten program for 4-year-olds that follows key principles of effectiveness identified in evidence-based programs. The amount of evidence of positive and enduring effects of high-quality preschool programs is unprecedented, especially for children at risk. There is not only a critical mass of evidence from long-term cost-benefit analyses, but increasingly strong evidence from state-financed prekindergarten that participation

is associated with sizeable increases in school readiness and transition to elementary school. These demonstrated increases in many programs are critical to the emergence of enduring effects. Economic analyses of the likely economic effects of upscaled and sustained programs consistently show that even under modest assumptions, prekindergarten programs for 4-year-olds would be expected to return more than \$2.00 per dollar invested. Considering a wider spectrum of effects that have been tested in other programs such as CPC, the return is likely to be more than \$4.00 per dollar invested.

Despite the accumulated evidence of consistently positive effects, states vary dramatically in prekindergarten participation. Twelve states have no state-funded programs. Of the 38 states that do fund part- or full-day programs for 4-year-olds, participation ranges from about 2% (Minnesota) to 70% (Oklahoma). In Minnesota, even with relatively low levels of state investment, preschool services are fragmented across funding streams. Based on 2005 funding levels, the expenditure per child for Early Childhood Family Education is \$270, School Readiness is \$280, and First Grade Preparedness is \$1,674. Only the Head Start program has an expenditure per child (\$7,122) that is large enough to promote enduring effects. The typical expenditure per child for a part-day program in most state-funded programs is \$3,000 to \$4,000.

Based on the accumulated research evidence and the proven success of states in developing early childhood development programs, greater investments are needed in state-funded programs where they do not now exist and in ensuring that current programs are high in quality, following the principles of effectiveness found in the most cost-effective programs. Among these are the provision of services that (a) are of sufficient length or duration, (b) have high intensity, (c) have low class sizes and ratios of children to teachers, (d) are comprehensive in scope, and (e) by well-trained and compensated staff.

2. Increase state investment in evidence-based school transition program and practices in the early grades. Although preschool programs can provide a strong foundation for school success, the importance of smooth transitions to elementary school should not be underestimated. School-based PK-3 programs have shown success in reinforcing preschool gains and promoting school success above and beyond preschool. Increased funding for PK-3 programs and practices also is warranted. Co-located and coordinated preschool and school-age programs, reduced class sizes in the early school grades, and parent involvement strategies appear particularly effective, as has been found in the CPC program.

In contrast, full-day kindergarten has demonstrated only small effects on school performance and these effects are mostly limited to the end of kindergarten. The cost effectiveness of full-day kindergarten is close to zero. Future studies are needed on the quality of implementation of full-day kindergarten, especially how the longer school day is organized and the amount of time spent on academic skills.

3. Use results of cost-benefit analysis to better prioritize funding of education and social programs. In a time of increasingly limited fiscal resources, greater scrutiny of existing

programs and services becomes essential. Cost-benefit analysis and other impact evaluations are especially important because they can identify the most efficient use of taxpayer dollars for crime prevention and other outcomes. Although there are many criteria to be used in funding decisions and not all effective programs are analyzed for returns, increased funding for and use of economic analyses of social programs are some of the best ways to determine the most efficient use of public investments in young people.

4. Develop funding mechanisms to support the implementation of early childhood development programs in a more timely manner. Because the effects of early education occur for educational, economic, and social outcomes, policy makers should consider a broader array of funding mechanisms to increase investments in the organization and implementation of effective ECD programs. It is important for state policy-makers to understand how long-term savings are achieved from initial investments. A similar issue arises at the level of state agencies. Most high quality ECD programs are broad in their impact, leading to reductions in a range of problematic outcomes and the promotion of a variety of positive developmental consequences. For example, investments in quality preschool programs not only benefit the educational system but also the welfare, juvenile justice and corrections systems. Among the new funding mechanisms to consider are the following:

- Issue state bonds for early childhood development programs that have a high probability of repayment within five to ten years based on the accumulated evidence. Although many states issue bonds to pay for general revenue programs and construction, the evidence of economic returns for preschool would provide a strong rationale for testing such a financing approach.

- Develop a check-off box on the state income tax form for voluntary contributions to early childhood development funding. As implemented in other states, taxpayers could contribute any dollar amount to ECD programs overseen by the state prevention commission or a specified government agency. Among the options for contributions could be preschool education, school transition programs, and birth to three services.

- Redirect a portion of funds from treatment to ECD programs. Current categorical funding for many education and justice system programs is heavily weighted toward remediation or treatment. Rebalancing the allocations even by a small percentage would provide needed funds for early education. For example, in K-12 education, state Departments of Education and local school districts receive millions of dollars per year in Title I block grants to schools serving low-income students. Nearly 95% of these funds are directed toward remedial education, while less than 5% go to preschool.

5. Increase investments in research and development (R & D) for evaluating the effects of early childhood development programs. Although studies of the long-term effects of early education are available, the number of studies is small and few cost-benefit analyses are conducted to assess economic benefits. The National Science and Technology Council estimates

that of the total annual expenditures of social programs for young people, only 1/3 of 1 percent goes to R & D along the lines of the evaluation research documented in this report. In comparison, national R & D investments in energy, biomedical sciences, and transportation average 2 to 3 percent of total expenditures (estimated by GDP). R & D investments are needed both to assess the effectiveness of existing programs and to support innovation to address emerging issues and needs at the local, state, and national levels. Resources should be set aside for developing new programs and for rigorously evaluating interventions. More research on alternative models of PK3 are needed, including the practices that contribute to impacts, including professional development, teaching practices, curricula, and resources for coordination across grades.

Footnotes

1. The benefits typically included in CBA are (a) reduced need for future remedial education services, (b) increased educational attainment or increased test scores, (c) reduced future crime costs (administration and treatment), (d) savings to victims of crime (tangible or intangible), (e) reduced costs in child welfare services (administration and treatment), and (f) improved health or associated averted medical expenditures. The benefits typically not included are (a) improved social and emotional outcomes, (b) social cohesion (or citizenship), (c) improved health of participant's future spouse and children, (d) increased educational attainment of participant's children, (e) increased saving, (f) increased charitable giving, and (g) increased test scores.

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