

THE ECONOMIC BENEFITS OF CREATING
CONNECTIONS:

A BENEFIT-COST PROJECTION FOR THE UNIVERSITY OF OREGON BRAIN
DEVELOPMENT LAB'S CREATING CONNECTIONS EARLY CHILDHOOD
INTERVENTION PROGRAM

by

NELSON VICTOR LINDGREN

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Professor William Harbaugh

This thesis is a benefit-cost projection for the University of Oregon Brain Development Lab's Creating Connections early childhood intervention program. Using student intellectual outcome results of classroom trials of the precursor PCMC-A preschool intervention tested in Head Start preschools in Lane County, Oregon, this analysis utilizes the determined benefit outcomes of several older and more extensively studied early childhood education programs to construct estimates of benefits students and society can expect from Creating Connections. This study projects costs of implementation of Creating Connections in several sizes of schools and school districts, and analyzes expected benefits resulting from the program under differing sets of assumptions, to create a range of benefit-cost ratios. Overall, this project determines that Creating Connections has a strong potential to provide high returns to investment, with a projected benefit-cost ratio of 22:1 under conservative restrictions.

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Table of Contents

Introduction	1
PCMC-A and CC Overview	3
Potential for Economic Benefits from Early Childhood Education	8
Literature Review	12
Structure of CC Used in Benefit-Cost Projection	19
Cost Analysis	21
Single Preschool	21
County-Wide Implementation	23
State-Wide Implementation	25
Parameters Included in all Models	27
Benefits Analysis	32
Published PCMC-A Outcomes	32
Child Benefits	32
Parent Benefits	36
Limitations of Benefit Prediction	36
Benefits Estimation Method	38
Direct Benefits	39
Avoided Costs	40
Discussion	46
Sensitivity Analysis	48
Potential for Unaccounted Benefits	51
Suggestions for Future Research and Limitations of Analysis	53
Conclusion	56
Appendix	58
Bibliography	59

List of Figures

Figure 1: Brain Electrograph of Control Group	34
Figure 2: Brain Electrograph of PCMC-A Experimental Group	34

List of Tables

Table 1: CC Single School Implementation	23
Table 2: CC County-Wide Implementation	25
Table 3: CC State-Wide Implementation	27
Table 4: Projected Benefits	45
Table 5: Benefit-Cost Ratios Under PCMC-A 8-Week Benefits Scaling Assumption	46
Table 6: Benefit-Cost Ratios Under 44-Week Benefits Scaling Assumption	46
Table 7: Required Percent of 8-Week Scaled Benefits for BCR to be equal to 1	49
Table 8: Summary of Benefit from Abecedarian and Perry Preschool Programs	58

Introduction

This thesis is a benefit-cost projection of the Creating Connections (CC) early childhood education program, a two-generation preschool program developed in partnership between the University of Oregon's Brain Development Lab (BDL) and Head Start of Lane County (HSOLC). The BDL is a research laboratory in the U of O Department of Psychology that has developed and assessed several evidence-based interventions for preschool children. This benefit-cost projection of CC is designed to provide an understanding of the expected returns to investment that the program has the potential to provide.

There is significant neuroscientific research that demonstrates the remarkable adaptability and plasticity of the brains of young children. Neuroplasticity, the ability of the brain to reorganize and create new neurological connections, is strong in young children, and this plasticity of the brain fades with age (Hodge, 2008). Indeed, researchers believe that as much as 90% of significant brain development in humans occurs before the age of five (USDE). This neuroscientific evidence demonstrates the importance of growth in neurobiological targets such as selective attention, a skill which has been linked to academic performance, and a skill that children of Head Start's target demographic often possess in reduced levels (Curry, 2000; Neville et al., 2013).

The goal of CC is to enrich the educational experience of students involved in Head Start preschools, in order to improve these children's intellectual potential, and as a consequence, each child's lifetime outcomes and accomplishments. This thesis constructs a benefit-cost projection of CC, to better allow the researchers involved in

developing the program, as well as those involved in the wider distribution of the program, to understand the economic potential CC holds. This thesis begins with an overview of BDL programs, and a description of how CC has been developed, followed by a discussion of the potential for lifetime economic benefits resulting from early childhood education, and a summary of the results of previous economic analyses of preschool programs. To construct benefit and cost estimates for CC, I propose an overall implementation model of the program, and describe means of estimating the costs and resulting benefits of implementing this program under differing implementation and participation assumptions. The thesis concludes with a discussion of the results of this benefit-cost analysis, and the limitations of this research.

PCMC-A and CC Overview

Since 2004, the BDL has been working with at-risk children involved in Head Start preschool programs in Lane County, Oregon, with the goal of improving many aspects of these children's intelligence, cognition, and emotional maturity that will assist them in their future education. In a series of pilot studies, the researchers from the BDL implemented and tested several versions of evidence-based interventions. The program that has shown the most significant benefits to both parents and children is Parents and Children Making Connections – Highlighting Attention (PCMC-A). In a rigorous assessment of PCMC-A, children's brain functions supporting selective attention, standardized measures of cognition, and parent-reported child behaviors all favored children randomly assigned to receive PCMC-A relative to two control groups (Neville et al., 2013). In addition, parents participating in the program reported reduced parenting stress and displayed improvements in specific aspects of language interactions with their children (Ibid). PCMC-A's child component consists of short, intensive intervention sessions that train specific aspects of attention, self-regulation, and emotional regulation. These components, incorporated into sessions referred to as Brain Train sessions, were added to children's education in sessions conducted outside of the conventional Head Start school day (Ibid). The program additionally includes training sessions to help parents continue their children's education outside of school hours, while improving parent-child relationships and interactions (Ibid). Previous research has demonstrated the effectiveness of intensive interventions with young children, and PCMC-A is not only an intensive educational program, but is additionally based on

psychological research on childhood brain development and neuroplasticity (Pakulak et al., 2015).

Dr. Helen Neville, the founding Director of the UO's Brain Development Lab, Dr. Eric Pakulak, the current BDL Acting Director, and their colleagues have published research presenting evidence for the effectiveness of PCMC-A. In these articles, they discuss compelling empirical evidence that indicates PCMC-A leads to cognitive improvements for the children involved, even over a short period of time. This is an encouraging result, and, as I will discuss in more detail later, there is evidence from preschool studies that have followed children for more than 30 years after their involvement in the programs that the intellectual improvements children manifest when they are preschool-aged can lead to success in their lives for decades to come.

CC is a BDL program that builds on PCMC-A. It is a different delivery model of the intervention designed to be integrated into existing Head Start programming and thus to be more widely implementable. CC integrates many components of PCMC-A into the Head Start classroom. Due to the long period of time required to collect and analyze intellectual outcome data for the children involved in these BDL preschool programs, outcome data are not yet available for children involved in CC. There are, however, data published by the BDL documenting the intellectual and emotional growth of children involved in PCMC-A. The goal of my thesis is to create a benefit-cost projection for a future version of CC less reliant on the BDL, with intellectual outcome estimations based on the available data from PCMC-A. The cost portion of my projection will be an informed estimation of the implementation costs of this modified

version of CC, based on the costs of current and previous BDL interventions, and data on compensation and operational costs of Head Start of Lane County (HSOLC).

Since its inception, several hundred families have participated in PCMC-A in select Head Start preschools in Lane County, Oregon. The program procedures are described in detail in the supplementary information to an article published by Neville et al. in the Proceedings of the National Academy of Sciences. I will present a summary of these descriptions here, to clarify the discussion of PCMC-A in this paper.

A cohort of children and their parents from Head Start preschools in Lane County volunteered to be involved in a BDL study involving PCMC-A, with the understanding that they could be randomly assigned to intervention or control groups (SI Appendix - Neville et al., 2013). After children and their parents were assigned to intervention or control groups, children were pre-tested to obtain base measurements of numerous characteristics, including electrophysiological measurements of selective attention, as well as tests of nonverbal intelligence, receptive language, and preliteracy (Ibid). Researchers also obtained parent and teacher reports of child behavior, parent self-report measures of parenting stress, and measures of parent language behavior from coded videotaped parent-child interactions (Ibid). There were two control groups. In the passive control group, participants received the regular Head Start curriculum for eight weeks. In the active control group, participants received a comparison program of equivalent intensity to PCMC-A called Attention Boost for Children, which focused primarily on child classroom training, with greatly reduced parent involvement compared to PCMC-A (Ibid). All groups were tested before and after the eight-week intervention period (Ibid).

After pre-testing, children and parents in the PCMC-A experimental group participated in the eight-week PCMC-A curriculum, which for children, involved weekly participation in 50-minute small group activities “designed to address the overarching goals of increasing self-regulation of attention and emotion” (Ibid). These activities took place outside of Head Start’s regular hours, concurrently with the PCMC-A parent sessions (Ibid). PCMC-A parent interventionists delivered an adapted version of the curriculum for parent involvement developed by the Oregon Social Learning Center called Linking the Interests of Families and Teachers (Ibid). During these sessions, parents worked with interventionists to learn and develop parenting and child-interaction techniques designed to increase consistency and predictability in the home environment (Ibid). The skills developed in these programs were also designed to aid parents in better assisting their children in their intellectual growth, and to help parents maintain consistency between education methods used in the classroom and in the home (Ibid). After the conclusion of PCMC-A, children were post-tested to obtain the quantitative measurements described briefly above and discussed at length in the publication by Neville et al. (Ibid).

CC is a second-generation refinement of PCMC-A, designed to maintain the core curricular components of PCMC-A, while creating a delivery model that is more easily integrated into Head Start curricula (Pakulak et al., 2015). BDL researchers hypothesize that participation in CC will result in positive outcomes in children similar to those seen in PCMC-A. Notably, the child component of CC is integrated into the Head Start classroom throughout the school year, as opposed to in a single eight-week period in PCMC-A (Ibid). Additionally, selected parenting strategies from PCMC-A

programming are integrated into teaching methods in CC (Ibid). These factors create the potential for greater improvements in CC than were realized in the eight-week PCMC-A outcomes. The parent component of CC is delivered in a small-group format similar to that of PCMC-A, and offers several different sessions for parents to attend (Ibid).

Potential for Economic Benefits from Early Childhood Education

Economic research has found that investment in early childhood education can deliver positive returns to investment (Barnett and Masse, 2005; Belfield et al., 2006). Unfortunately, it is difficult in many cases to assign definitive monetary values to the more theoretical concepts involved in analyzing an individual's life. However, previous economic research assigns economic value resulting from early childhood education to two main categories: individual benefits and societal benefits. First, I will discuss individual benefits.

When children receive a high-quality education, they directly benefit from this education in both the short and long run (Barnett and Masse, 2005; Belfield et al., 2006; Demming, 2009; Gibbs et al., 2011; Reynolds et al., 2002). When young children's cognitive and emotional abilities are nurtured to assist them in performing better in an educational environment, it is suggested these children have the potential to improve their performance in their next 12 years of elementary education (Barnett and Masse, 2005; Belfield et al., 2006; Reynolds et al., 2002). Previous studies have found that a strong preschool education increases an individual's likelihood of succeeding in and graduating from high school, as well as increasing an individual's probability of receiving a secondary education (Barnett and Masse, 2005; Belfield et al., 2006; Reynolds et al., 2002). The Abecedarian study (discussed in more depth in literature review) found that students involved in the Abecedarian Intervention were almost three times as likely to attend a four-year college after high school graduation as their peers of comparable socioeconomic status in a control group (Barnett and Masse, 2005).

US Department of Labor Statistics data from 2015 finds that attending college, even if one does not obtain a degree, leads to decreases in unemployment rates and increases in income. Graduates from a four-year college, on average, have a 48% lower unemployment rate and receive a median income 168% higher than those with only a high school diploma (USDLS, 2015). There are many other methods of studying the relations between cognitive ability, income, education levels, and life outcomes, and I discuss this matter in the later benefit-cost analysis. However, I provide these cursory statistics in order to indicate the potential for career achievement and individual benefit that an effective early childhood education program can provide to children. A given individual who performs better in school, attains higher levels of education, and learns more valuable skills has the potential be a more productive member of the labor force during their adult life, and on average receive significantly higher income for their efforts.

Education can also create societal economic benefits. Indeed, Barnett and Masse, as well as Belfield et al., find that a large proportion of the monetary benefits created by the Abecedarian and Perry Preschool programs accrue not to the children involved in the programs, but to others (Barnett and Masse, 2005; Belfield et al., 2006). To this end, studies have found evidence of increases in the incomes of the mothers of children attending the preschools. This benefit was most apparent in the Abecedarian project, where children were, as part of the program, given subsidized, high quality child care for a full work-day, five days a week. This provision of this childcare appears to increase the ability of mothers to pursue work and educational opportunities of their own (Barnett and Masse, 2005).

Besides the parents of participating children, benefits from early childhood education may accrue to society at large, in cases such as the decreased criminal damages caused by children involved in the Perry Preschool (Barnett and Masse, 2005; Belfield et al., 2006). Reynolds et al., in their study of the Chicago Child-Parent Centers, also found a significant reduction in the incarceration rates of preschool program participants, and this lower rate of incarceration represented huge benefits to society, both by preventing the destructive consequences of criminal activity, and reducing the burden to society of incarceration of convicted criminals (Reynolds et al., 2002).

Additional societal benefits that can result from effective early childhood education programs stem from decreased dependence on government assistance such as the Supplemental Nutritional Assistance Program and Medicaid. Both the Abecedarian and Perry programs found evidence of increases in an individual's earnings and likelihood of employment, as well as decreases in their likelihood of relying on social assistance programs (Barnett and Masse, 2005; Belfield et al., 2006).

Nobel laureate in economics James Heckman discusses in numerous publications the theory of human capital, and how rates of return to investment in human capital vary widely based the stage of life at which the investment is made (Heckman, 2006). Heckman concludes that preschool education is underfunded in the United States, and that investment in early childhood education has the potential to reap much greater return than attempts to improve an individual's educational fate later in their lives. Indeed, Heckman states that "Investing in disadvantaged young children 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.” (Heckman, 2006).

This discussion of the potential for economic benefits resulting from early childhood education is meant to motivate the theoretical underpinnings of how and why significant investment in successful preschool programs has the potential to effect real and significant change in the lives of not only children who have the opportunity to participate in these programs, but to society as a whole. I will now turn to a review of important literature examining the outcomes of intensive early childhood education programs, and subsequently, utilize these studies as a basis for constructing a benefit-cost projection of CC.

Literature Review

Much of my discussion in the following review of research will be focused on relating PCMC-A and the short-term outcome data that is available for this program to short- as well as long-term results from several studies of intensive early childhood education programs. The outcomes of these studies will then be used to estimate the long-term benefits of CC. As I will discuss in greater detail below, many of the economic benefits of early childhood education, and indeed education at all levels, cannot be observed until a child has entered the labor force and adult life. This makes the following studies that utilize long-term follow-up data for decades after children have left the preschool programs especially valuable resources.

There are three preschool programs discussed extensively in the remainder of this analysis that have followed children for an extended period of time following their involvement in an intensive preschool program. Over this period, the studies observed data such as educational attainment, health statistics, crime rates, employment statistics, and income information of the children from these preschool programs throughout a significant portion of their adult life. These programs – the Abecedarian Early Childhood Intervention Program, the High/Scope Perry Preschool Program, and the Chicago Child-Parent Centers, will form a valuable body of comparison for my analysis of the BDL’s programs.

While improvements in children’s intelligence, academic potential, and emotional maturity are desirable outcomes, from an economic perspective, one must look at these outcomes quantitatively, and consider alternative uses of the funds allocated to educational programs. Barnett and Masse, in their comprehensive benefit-

cost analysis of the Abecedarian Early Childhood Intervention, motivate the importance of investigating not only whether a program is quantitatively effective at improving children's intellectual potential, but also whether the program represents a "sound social investment" (2002). A fundamental task of the science of economics is to determine, in the face of scarce resources, the socially optimal allocation of these resources. In light of the proven positive effects PCMC-A has had on its participants, it is important to consider the economic costs and benefits of these effects. It is my intention to compare the short-term outcome metrics of PCMC-A to the short-term metrics of these following long-term studies, in order to gain an appreciation for the possible long-term benefits to be derived from PCMC-A, and thus CC.

While the economic importance of a benefit-cost analysis of social programs such as preschools might seem apparent, few of the numerous preschool programs in the United States have been subjected to a comprehensive benefit-cost analysis. In the following paragraphs, I will discuss three studies that have conducted a comprehensive analysis of early childhood education programs, as well as research that has examined the outcomes of Head Start preschools. I will additionally discuss previous research from U of O Economics students that has examined benefits and costs of PCMC-A.

The Abecedarian Early Childhood Intervention is the gold standard of intensive early education. Started in the 1970s at the University of North Carolina at Chapel Hill, the program involved treatment and control groups, drawn from a mostly African-American population of at-risk young children (Barnett and Masse, 2005). The program provided education for its participants for the most comprehensive timeframe of any study I will discuss: up to 10 hours a day, five days a week, 50 weeks a year, for

children several months old through their entrance into kindergarten (Ibid). The program also collected comprehensive follow-up data on the program participants, and used this follow-up data to compare participants to a randomly assigned control group (Ibid). This control group was provided child-care for similar time periods to the experimental group participants, but did not benefit from the preschool experience of the experimental group children (Ibid). The analysis by Barnett and Masse demonstrates significant improvements created by the program, including increased maternal employment, decreased K-12 schooling costs, increased lifetime employment and income for the students, and increases in various health parameters of the participants (Ibid). Notably, participants in the Abecedarian preschool demonstrated significantly lower smoking rates than the control group, which led to significantly lower personal and societal healthcare costs, and personal and societal gains from workforce productivity due to time not lost to health deterioration and early death due to smoking (Ibid). The overall analysis conducted by Barnett and Masse suggests a positive benefit-cost ratio of 2.5 to 1 (Ibid).

The High/Scope Perry Preschool Program is a valuable comparison to the Abecedarian Project, as it is the only other previously studied early childhood education program to involve a randomly assigned control group, adding, as it does for the Abecedarian project, increased interpretive power to the findings of the study. The Chicago Parent Child Centers, which I will discuss later, unfortunately lack this control group. The Perry Preschool program was structured in a similar manner to the Abecedarian project, with low income, at-risk children in Michigan attending an intensive preschool, but for notably shorter periods of time than the students in the

Abecedarian project (Belfield et al., 2006). In the Perry Preschool program, children three and four years old were offered preschool for 2.5 hours per day, five days a week during the academic year (Barnett and Masse, 2005). This results in approximately 70 fewer instructional days per year for these children, and significantly shorter periods of instruction, as opposed to the Abecedarian preschool (Ibid). The Perry Preschool, however, included home-visits and tutoring for parents, a notable similarity with PCMC-A (Ibid). The Perry Preschool also collected long-term follow-up data from the participants in the program, and a 2006 benefit-cost analysis by Belfield, Nores, Barnett, and Schweinhart, uses the age-40 follow-up panel of data to demonstrate compelling benefits of the experimental group as compared to the control group in many of the same characteristics as the Abecedarian project. As a consequence of its much shorter instructional period, the Perry Preschool Program is significantly less expensive on a per-child basis than the Abecedarian project, which leads to its impressive benefit-cost ratio of 12.9 to 1 (Belfield et al, 2006).

The Chicago Child-Parent Centers are early childhood education programs located in public schools throughout Chicago that provide education and childcare for low-income, at-risk children from ages three to nine (Reynolds et al., 2002). This program, as I mentioned before, unfortunately lacks a randomized control group, but Reynolds, Temple, Robertson, and Mann, in their 2002 benefit-cost study, create a synthetic control group using matched pairs of students from the Chicago Longitudinal Study (Ibid). The program provides educational instruction for three hours per day, five days per week during the academic year, and also includes a six-week summer session, making it most comparable to the Perry Preschool Project in terms of instructional day

length, although the Chicago Child-Parent Centers serve a wider age-range of children (Ibid). The Chicago Child-Parent Centers' results show increases in their students' lifetime earning potential, decreased K-12 schooling costs, and increased rates of high school graduation, among many other positive metrics shared with the previously discussed studies.

The Chicago Child-Parent Centers also provide data strongly indicating the impact of early childhood interventions as opposed to elementary school-aged interventions (Ibid). The benefit-cost ratio determined by Reynolds et al. is 6.11 to 1 for the extended time-period intervention, beginning when children are three and continuing until they enter elementary school (Ibid). In contrast, the elementary school-aged intervention conducted at the Chicago Child-Parent Centers yields a much smaller, yet still positive, benefit-cost ratio of 1.66 to 1 (Ibid). This result adds to the motivation to start childhood education programs earlier in a child's life, as attempting to help children in their intellectual development becomes harder, and perhaps less economically effective, as the children get older (Heckman, 2006). It is worthy of note that there is research suggesting that there are other periods of an individual's life where targeted interventions can be effective, such as adolescence; Heckman asserts, however, that preschool interventions, as compared to programs for older students, are significantly underfunded in the United States (Ibid). Preschool programs, then, perhaps have the best potential to reap a high return to investment, as they are currently underdeveloped, and their development could be furthered for a relatively low cost.

Head Start, the program in which PCMC-A and other BDL programs are situated, is a preschool program funded by the US Federal Government for

disadvantaged three and four-year-old children. Since its inception as part of President Johnson's "War on Poverty," Head Start received mixed political and social support, and while Head Start does appear to assist its students in some parameters, it has not yet achieved the quantifiable student success for which many have hoped (Curry, 2005). There is push-back to this claim, however, and there are publications that argue that criticisms of Head Start's effectiveness are premature. David Demming asserts in his research examining pairs of siblings (one who participated in Head Start, one who did not), that Head Start does create significant improvement in adult outcomes for participants, and other publications have argued that Head Start can lead to increased educational attainment, especially for those students from vulnerable demographic groups such as females, blacks, and hispanics (De Haan et al., 2015; Demming, 2009; Gibbs et al., 2011; Zhai et al., 2011).

This dynamic, as well as other political concerns, have created a complicated political environment for Head Start, and despite disagreements about its success, the program has seen funding cuts in the last several decades (Curry, 2005). One goal of the BDL programs has been to take an evidence-based approach to improving Head Start, and to improve the outcomes of children participating in Head Start, regardless of the magnitude of the underlying Head Start benefits.

Two previous papers by pairs of economics students at the University of Oregon have examined the benefit-cost ratio for Brain Development Lab programs. In 2006 Yaillen and Blair conducted their analysis on a precursor program to PCMC-A conducted by the BDL, and in 2009, Pierce and Rao examined early results of PCMC-A. Each paper showed positive returns to investment for spending on the BDL

education programs, and evidence of continued improvement in the lives of the program participants (Pierce and Rao, 2009; Yaillen and Blair, 2006). These conclusions, as well as the findings of all the studies I have discussed in this review, add confidence to my hypothesis that CC has the potential to have a significant and positive return to investment.

Structure of CC Used in Benefit-Cost Projection

CC is currently in its fourth year of application in Head Start preschools in Lane County, Oregon. The program structure that is assumed in the following Benefit and Cost Analyses is meant to simulate CC implementation in classrooms in the same way that the current program is run in Lane County, but in a manner not reliant on the University of Oregon or the Brain Development Lab. This proposed structure of CC would thus include integration of Brain Train curriculum throughout the 44-week Head Start school year and the integration of select parenting techniques from PCMC-A into the teaching methodologies used by teachers. The following projections include all pertinent intervention costs such as trainings of teachers, materials, and the costs of parent training sessions and attendance incentives, but do not include the costs for any research activities, as these simulated preschools are proposed to exist separately from BDL research activities, and these costs are not relevant for a fair discussion of the benefits and costs of CC.

These estimates are designed under a marginal benefit and cost framework assuming CC curriculum is added to the curriculum of existing Head Start preschools and Head Start school districts. However, the UO BDL is interested in making this curriculum available to existing preschool programs not affiliated with Head Start, and these estimates should be reasonably representative of the costs of program implementation in any existing preschool or educational system of appropriate size.

As these scenarios all examine implementation of CC in existing preschools, the base operating cost of the preschool is not taken into account. The data that have been examined regarding student performance from PCMC-A compares the experimental

group students to a control group of students involved in normal Head Start curriculum. Thus, educational gains anticipated to be attributable to CC will be discussed in terms of benefit added to any underlying benefits of the standard Head Start curriculum.

The overall efficacy and return to economic investment of Head Start itself is an interesting question in need of further study; however, this question is outside the scope of this project, and the following analysis focuses specifically on the marginal benefits and costs of CC. Both the benefits and costs that will be discussed further in this section are comparing the marginal benefits and costs of a Head Start preschool program utilizing the Creating Connections curriculum, as compared to a Head Start preschool that is using conventional Head Start curriculum. These additional benefits and costs associated with the introduction of CC, as opposed to the Head Start base curriculum on which it rests, are the focus of this benefit-cost analysis.

Cost Analysis

In this section, the expected costs of implementation of CC will be described, within three different expansion frameworks. I have constructed models for CC implementation for (1) a single preschool, (2) all Head Start preschools run by Head Start of Lane County (HSOLC), and (3) all Head Start preschools in the State of Oregon. The primary costs of CC implementation are the costs of program administration, teacher training, parent attendance incentives, and materials for students and parents. The levels of administration required, and the extent to which it is possible to integrate staff trainings into the regular operations of the school vary with the size of the implementation scale. Through consultation with interventionists and educators involved in the implementation of CC, I have developed estimates of the administrative staffing, training, and implementation costs of the program. The training and administrative costs of the program fluctuate most based on the scope of the intervention, and these differences are discussed in more detail below. The program costs that remain constant in the three implementation proposals are included in all tables, and described in detail following the cost discussion for the three implementation scalings.

Single Preschool

For the single preschool model, costs are projected for a single preschool with approximately 90 students. As this model is not integrated with the administrative structure of Head Start, this small-scale model is applicable equally to a single non-Head Start preschool implementing the CC curriculum. The additional costs of teacher

salary due to CC in this model are the salary costs of paying head and assistant teachers' salaries for three days of trainings in CC methodologies and curriculum use. Additional training costs are involved for the teachers who will lead the parent intervention sessions. A 0.5 full time equivalent (FTE) CC specialist will conduct trainings for teachers and oversee program implementation, and oversee 12 hours of fidelity checks and additional trainings with each teacher throughout the school year, in addition to ensuring general efficacy of the program. Support staff for the CC specialist will make phone calls to encourage parent attendance, and assist teachers with materials preparation. The required number of teachers, and thus their training costs, are a variable cost, fluctuating closely with the number of students in the preschool, and consequently, the number of parent sessions required throughout the school year. Administrative costs are a relatively fixed cost, as there is a significant demand for management and management support staff even for this single school model, yet the management requirements increase relatively slowly as the number of students involved in the program grows. These costs are presented in Table 1.

Single Preschool Costs:		
Parent Intervention Costs:		
Teacher Trainings:	\$	652
Teacher Salary for Sessions:	\$	6,286
Childcare Costs:	\$	11,871
Food Costs:	\$	6,075
Incentive Costs:	\$	13,500
Parent Intervention Sub-Total:	\$	38,383
Classroom Instruction Costs:		
Trainings for Teachers:	\$	7,579
Materials Costs:	\$	6,750
Classroom Instruction Sub-Total:	\$	14,329
Management/Oversight Costs:		
CC Specialist:	\$	19,514
CC Specialist Support Staff:	\$	1,500
Management Sub-Total:	\$	21,014
Total Single Preschool Costs:	\$	73,726
Number of Families Served:		90
Average Per-Family Cost of CC Program Implementation:		
	\$	819

Table 1: CC Single School Implementation

County-Wide Implementation

The costs of a medium-scale roll-out of CC will look at extending the CC curriculum into all Head Start preschools in Lane County, Oregon. Head Start of Lane County educates just over 1,000 students, in approximately 60 classes. This comparison is based on estimates the BDL has developed for broadening the reach of their program beyond the Head Start classes that have participated in the BDL research studies over

the past decade. The BDL estimates that extending the CC curriculum into all Head Start classrooms in Lane County would require the creation of a dedicated full-time position, to serve as the district-wide Creating Connections Specialist. Filling a role similar to that of the CC specialist in the previous model, this individual would lead trainings in the CC curriculum for the teachers and aides working in the school, as well as trainings of the teachers who would administer the parent sessions of the curriculum. This specialist would be in charge of general program oversight throughout the school year, and supervise support staff who would make phone calls to encourage parent attendance at parenting sessions. These support staff would additionally help with materials preparation and general program assistance.

This county-wide implementation model, as opposed to the single-school implementation, requires lower administrative staffing costs on a per-student basis, and significantly lower overall program costs per-student. Based on the current structure of HSOLC, it is estimated that if schools fully integrated CC into the curriculum of all HSOLC preschools, there would be decreases in additional training hours needed for CC curriculum outside of the trainings that already occur as part of the Head Start staff's in-service training that occurs at the beginning of each school year. The additional time required for trainings is estimated to be 1.5 days in this county-wide model, as opposed to three days in the single-preschool model. Fidelity check-ins with the Head Start teachers are also expected to require approximately half as many hours, as CC check-ins will be integrated into other recurring trainings occurring throughout the school year. Table 2 presents these costs.

Lane County Costs:	
Parent Intervention Costs:	
Teacher Trainings:	\$ 4,563
Teacher Salary for Sessions:	\$ 75,427
Childcare Costs:	\$ 142,447
Food Costs:	\$ 69,795
Incentive Costs:	\$ 155,100
Parent Intervention Sub-Total:	\$ 447,332
Classroom Instruction Costs:	
Trainings for Teachers:	\$ 44,716
Materials Costs:	\$ 77,550
Classroom Instruction Sub-Total:	\$ 122,266
Management/Oversight Costs:	
CC Specialist:	\$ 68,550
CC Specialist Support Staff:	\$ 10,088
Management Sub-Total:	\$ 78,638
Total Lane County Costs:	\$ 648,235
Number of Families Served:	1034
Average Per-Family Cost of CC Program Implementation:	\$ 627

Table 2: CC County-Wide Implementation

State-Wide Implementation

In a state-wide rollout of CC, I examine the costs of expanding CC into all Head Start classrooms across the state of Oregon. As in the county-wide implementation model, per-student cost is expected to decrease in this model due to increased potential for integration of the program into the existing Head Start education framework. It is estimated in this scenario that one full-time CC Specialist and one support staff member would be required for each 1,250 students. It is possible that specialists in urban areas

could oversee a larger number of students, and that one specialist could work with a smaller student load spread over several smaller areas in the more rural portions of the state. This metric is certainly an approximation, but is a reasonable manner of considering the trade-offs involved in a wide-scope implementation with more central oversight. The model includes an estimate for two additional CC specialists to serve as overall administrators for the state-wide program.

In this model, the BDL believes there is potential for integration of CC trainings into existing training procedures, and I estimate that the staff time required for trainings could be decreased to one day per year, with six hours of follow-up trainings occurring throughout the year, as is included in the county-wide implementation. The state-wide model observes a decrease in per-student costs of approximately 20 dollars, primarily due to the decreased training time required for teacher trainings, and larger student bodies that CC specialists would oversee. Table 3 presents these costs.

State of Oregon Costs:		
Parent Intervention Costs:		
Teacher Trainings:	\$	47,693
Teacher Salary for Sessions:	\$	919,793
Childcare Costs:	\$	1,737,057
Food Costs:	\$	887,558
Incentive Costs:	\$	1,972,350
Parent Intervention Sub-Total:	\$	5,564,450
Classroom Instruction Costs:		
Trainings for Teachers:	\$	430,903
Materials Costs:	\$	986,175
Classroom Instruction Sub-Total:	\$	1,417,078
Management/Oversight Costs:		
CC Overall Management Specialists:	\$	137,100
CC Specialists:	\$	721,091
CC Specialist Support Staff:	\$	106,118
Management Sub-Total:	\$	964,309
Total Oregon Costs:	\$	7,945,837
Number of Families Served:	13,149	
Average Per-Family Cost of CC		
Program Implementation:	\$	604

Table 3: CC State-Wide Implementation

Parameters Included in all Models

In all models, the salaries of administrators, as well as the salaries of teachers and teaching assistants, are based on salary and benefit costs of employees of Head Start of Lane County. These salaries are believed to be reasonably representative of average costs of employment for Head Start employees throughout the state of Oregon,

and to represent very accurate wage estimates for the Lane County implementation scenario.

Parental incentives offered as part of the CC curriculum include childcare offered during the parent sessions, food provided to parents and children attending the sessions, and monetary incentives in the form of cash or gift cards given to parents to encourage their attendance at the parent sessions. These costs, as they are estimated on a per-child and per-family basis, do not change in my estimations of per-child costs across implementation scenarios. There is, however, potential for the per-child costs of these programs to decrease with scaling up of the program, as I will discuss at the end of this section.

Incentive costs form a significant portion of the overall costs of the program, however, the BDL believes that these incentives are important, as during implementation of both PCMC-A and CC, the incentives appeared to be an important factor encouraging parent attendance at parent sessions. Another factor included proximity of the parent session to where parents lived – sessions were not always at the school which was attended by these parents' children. These costs account for parent sessions being offered at each preschool involved in the program, which could contribute to improvement in parent attendance. Parent involvement in the program appears to be an important component of the success of PCMC-A; in trials of PCMC-A, the BDL researchers compared student and parent results from PCMC-A to a control group involved in normal Head Start curriculum, as well as an active control group which emphasized child educational components and included significantly less parent involvement (Neville et al., 2013). This active control group was intended to provide

the research “a realistic, competing model for child attention training that was more child-focused” (Ibid). In their analysis, Neville et al. discuss that PCMC-A demonstrated significantly larger effects in child and parent quantitative measurements, leading the BDL to conclude that the more intensive involvement of parent education in PCMC-A represents an important component of the program’s success (Ibid). Considering the effectiveness of the parent educational components of the program, the BDL believes that including the parent sessions and incentives to encourage attendance at these sessions represent a key determinant of student success, and justify the relatively high cost of this portion of the program.

A study conducted by Nina Heinrichs in 2004 tested the effects of monetary incentives in encouraging parents to attend parenting sessions through their children’s preschools. This study, conducted in Germany with parents of lower socioeconomic status, was based on a parent education system that bore many similarities to the parent component of CC, training parents in “17 core child management strategies” (Heinrichs, 2004). These strategies were designed to promote children’s education and development, while also improving aspects of parenting consistency and parent-child interaction (Ibid). The parent program trialed by Heinrichs was offered to parents in forms with and without monetary incentives for attendance, and the programs involving monetary attendance incentives resulted in significant improvements in parent recruitment and attendance for group education sessions, as well as improved participation in follow-up phone calls. The maximum potential incentive amount received by parents in this study was 110 euros, which at the time of publication was roughly equivalent to 145 US dollars. Based on this research, \$150 is proposed in this

cost analysis as the maximum potential incentive offered to parents, with some portion of the incentive distributed after each session, and a bonus being given if parents attend all 8 sessions. The incentive costs are estimated assuming each family attends the parent sessions, and receives the maximal potential incentive, to give an upper bound on costs of the incentives.

Estimates for childcare and meals provided during the parent sessions are based on Bureau of Labor Statistics median hourly wages, Head Start of Lane County's employee benefit rates, and commercial food-service rates for meals from a school's cafeteria. Ten childcare workers are estimated to be available for each parent session, which is expected to draw approximately 45 children. These child-care ratios are consistent with previous trials of the BDL parent intervention program. An overall materials cost of 75 dollars per student involved in the program is estimated to capture the cost of materials for the students during their classroom Brain Train activities, as well as materials for the child's parent(s) used during the parenting sessions. This estimate is also derived from the previous costs of materials observed in BDL program use.

The estimates discussed for the costs of CC implementation in this section are designed to be an accurate, yet conservative accounting of costs. The improvements I have assumed to manifest from increasing the scale of implementation are what I have determined, in consultation with the researchers of the BDL, to be the minimal improvements that would likely result from increases in administrative efficiency, potential for CC integration into existing training and skills-maintenance procedures, and other forms of decreasing costs due to increases in the scale of implementation. It is

possible that in reality, particularly in the years following initial implementation of this program, the program could be almost completely integrated into existing training and administrative procedures of the schools, further decreasing the additional costs of the program as opposed to the pre-existing preschool. This is especially true for the state-wide implementation model, as the larger-scope introduction of CC presents the most potential for systematic changes in the way that Head Start curriculum is structured and Head Start teachers are trained in the state of Oregon, such that a long-term implementation of the program could incur increasingly minimal increased costs beyond the existing costs of operating the Head Start preschools. The projected statistics for the county-wide implementation scenario are likely the most accurate, as they are based on precise salary, administrative structure, and student enrollment statistics for Lane County, Oregon. The estimates regarding single preschool and state-wide implementation scenarios, however, are meant to provide useful comparisons for the effects of smaller and larger implementation scenarios.

Benefits Analysis

While the costs described above are relatively straightforward to account for and document, quantifying the benefits received from an educational experience is more difficult. The studies discussed in the literature review that examine several decades of follow-up data on student outcomes after participating in an intensive preschool program present a valuable means of comparison to estimate the benefits that CC could create for its students. Based on the short-term cognitive improvements documented from PCMC-A, I have developed several methods of comparing the likely future benefits of CC to the benefits documented in previously conducted studies. First, I will discuss the cognitive and emotional improvements that PCMC-A has been shown to create for its students.

Published PCMC-A Outcomes

Neville et al. discuss in detail the changes and improvements observed in students participating in PCMC-A. These benefits can be categorized by looking separately at demonstrated child and parent improvements.

Child Benefits

Using electrophysiological measures of children's brain function, the BDL has shown that children who have participated in PCMC-A demonstrate significant improvements in their neurological capability for selective attention, measured via an event-related brain potential paradigm (Neville et al., 2013). The researchers observe children's brain activity while the children are participating in controlled laboratory attention-related tasks, to determine "whether the PCMC-A program, which specifically

targeted selective attention, improved brain functions supporting selective attention in children relative to the two comparison groups” (Ibid). The results of the BDL study determine that students involved in PCMC-A demonstrate increased neural response and potential for selective attention, compared to both control groups involved in the study. The changes in children’s brain function and their potential for selective attention can actually be observed by the untrained eye in the following topographic images reproduced from Neville et al. These images demonstrate the neural response of the children’s brains to stimuli measured before and after program intervention. The first set of images depict pre-and post-test results for children involved in the Head Start only control group, where the researchers detect no significant differences in brain activity (Neville et al., 2013). The second set of images depict pre- and post-test results for children involved in the PCMC-A experimental group, and the increases in neural activation can be observed in the larger red regions of the electrograph (Neville et al., 2013).

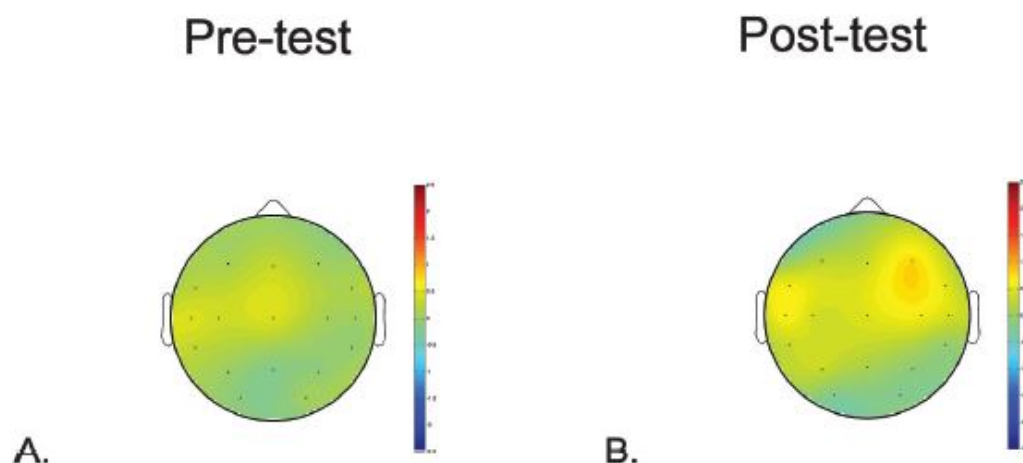


Figure 1: Brain Electrograph of Control Group

Student's brain activation who received Head Start only – image reproduced from Neville et al., 2013 – Supplementary Information Appendix.

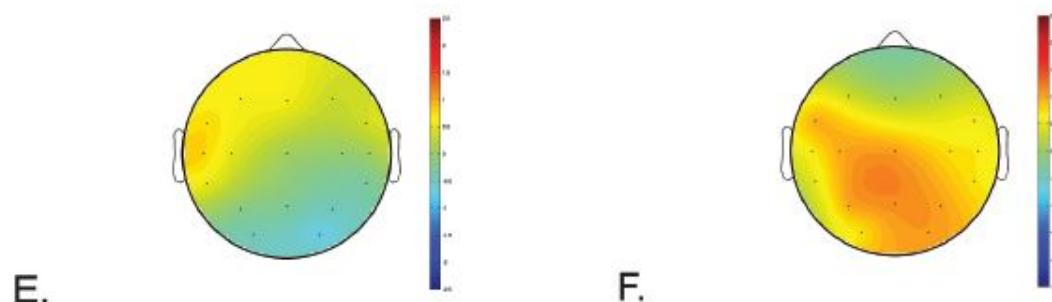


Figure 2: Brain Electrograph of PCMC-A Experimental Group

Student's brain activation who received PCMC-A intervention – image reproduced from Neville et al., 2013 – Supplementary Information Appendix.

These measures, as well as standardized tests of children's cognition, serve as the primary means of evaluating performance of PCMC-A outcomes for Neville et al. (Ibid). The authors additionally consider parent and teacher assessments of student

behaviors, as well as self-assessments and laboratory test results of parents involved in PCMC-A, as secondary outcome measures (Ibid).

As the authors discuss at length in their own study, the measure of selective attention has been shown to be lower in children of lower socioeconomic background, and potentially has important and far-reaching effects in a child's intellectual potential (Ibid). Classroom trials of PCMC-A have also demonstrated significant student improvements on standardized assessments of non-verbal IQ and language (Ibid). These tests are considered by the BDL researchers to be of particular importance, as these skills, especially language, have the potential to contribute strongly to a child's academic achievement in their following education (Ibid). During PCMC-A trials, both teachers and parents of students reported students' behavior using a standardized rating system analyzing "social skills and problem behaviors" of preschool-aged children (Ibid). Parent results reported increased improvement in their children's behavior and social skills, compared to both normal Head Start students as well as participants in the active control group (Ibid).

These metrics measuring student performance combine to create a strong basis for the assertion that PCMC-A creates measurable improvements in children's cognitive and emotional states, over an intervention period of only 8 weeks. This research is also notable, as Neville et al. discuss, for showing that "neural systems mediating selective attention, a foundational skill for cognitive development, are malleable, and they show that these neural systems can be improved in lower SES [socioeconomic status] children in the relatively short timeframe of 8 wk through a family-based training format" (Ibid). These remarkable outcomes create a strong motivation for the economic potential of

these psychological, neurological, and physiological improvements in children, and form the scientific basis of the assumed cognitive growth in the benefit construction of this study.

Parent Benefits

Parents of the children involved in PCMC-A answered pre- and post-program questionnaires, and reported improvement in their parenting stress levels after completing the program (Ibid). Neville et al. additionally report that in observed interactions with their children, participating parents showed “favorable changes” in their interactions with their children, including increased turn-taking and improved language use with their children (Ibid). These parent characteristics are thought to be a contributing factor to improvements in child language development as well as other aspects of the lasting psychological and emotional well-being of the children (Ibid).

Limitations of Benefit Prediction

In attempting to predict effects of CC on children’s future outcomes, I am unable to examine or discuss observed long-term effects of the program, as the program has not been in existence long enough for students to experience these effects. There is an ongoing longitudinal study following students who participated in PCMC-A through their elementary school education, and analyses of these data are ongoing. Given the importance of developing an understanding of possible outcomes of the program now, in order to influence program refinement and determine the utility of continuation of the program, the benefit analysis of this thesis refers to the previously conducted benefit-

cost-analyses discussed in the literature review, in order to create a prediction of outcomes that can reasonably be expected for CC.

Comparing outcomes across different preschool programs, where researchers utilized differing measurement metrics of both short and long-term student achievement is challenging. However, there are several key aspects of CC, as well as the programs with which I will draw comparisons, that allow for some general similarities to be assumed between programs. Some of the key areas in which I intend to estimate future benefits of CC are in the areas of individual educational attainment, income, societal benefit due to avoided costs, and health benefits.

The curriculum of PCMC-A, as well as the short-term cognitive improvements PCMC-A has been shown to foster in students, support the conclusion that PCMC-A creates intellectual improvements comparable to the intellectual benefits of other intensive preschool programs over an eight-week duration. Thus, it has been assumed in previous research discussing the economic potential of PCMC-A that scaling the benefits shown to emanate from comparable better-studied preschool programs is a reasonable method for estimating benefits of PCMC-A, and thus CC (Yaillen and Blair, 2006; Pierce and Rao, 2009). Scaling benefits from programs such as the Perry Preschool and Abecedarian study to the length of PCMC-A can provide a useful estimate for the minimal long-term benefits that PCMC-A can be expected to create for its participants. CC uses similar educational methodologies to those of PCMC-A, employed in the classroom throughout a 44-week Head Start instructional year, as opposed to the eight-week PCMC-A intervention.

Benefits Estimation Method

I have constructed two estimates of the long-term benefits of CC. The most conservative estimate assumes the cognitive improvements of PCMC-A will continue to occur in CC at the same levels as they did in the previously discussed studies of PCMC-A. While it is entirely likely, in the opinion of the researchers involved in CC, that the 44-week length of CC will foster larger and more significant cognitive growth than the eight-week length of PCMC-A, this estimate will rely only on published outcome data, and is thus meant to serve as a conservative and defensible baseline estimate of the economic benefits of CC.

This conservative estimate of CC future benefits, based on the intellectual growth assumption discussed above, is estimated in this paper by examining demonstrated benefits from the benefit-cost analyses of the Perry Preschool and Abecedarian programs, and scaling these benefits from the length of studied program (Perry length = 72 weeks; Abecedarian length = 250 weeks) to the eight-week duration of PCMC-A.

A second estimate of the long-term benefits of CC are made by scaling observed benefits of the Perry and Abecedarian preschools to the 44-week length of CC. While there are not yet concrete data on student performance to fully justify this assumption, the format of CC and prior results from PCMC-A suggest that this is a reasonable assumption. Indeed, the overall gains students demonstrated in non-verbal IQ for the eight-week long PCMC-A were nearly as large as the gains demonstrated in the full-program outcomes of the Perry and Abecedarian preschools, implying that this 44-week scaling estimate may be accurate in its estimation of the effects of CC, and that the

estimation scaled to the eight-week program could be an underestimation (Neville, 2013; Belfield et al., 2006; Barnett and Masse, 2005).

All benefits described in this thesis are estimated at a three percent discount rate with dollar values adjusted to 2016 US dollars to allow for comparison to the previously described cost estimates, which are expressed in 2016 US dollars and based on the 2016-2017 school year salary scale for Head Start of Lane County. The assumption of scalability is a strong assumption: the benefit estimation of this paper relies both on the concept that it is fair to scale benefits of a studied program to a shorter time length to determine the benefits of a comparable shorter length program, and additionally on the condition that PCMC-A (and thus CC) constitute a suitable comparison to the programs from which the scaled benefits are determined. While working under these assumptions is not optimal, it is essential to allow for the estimation of benefits of CC, given the impossibility of obtaining long-term life outcome data for program participants at this early stage in the program's history. The choice of the Perry Preschool benefit-cost analysis results as the reference for the important category of increased income in both models is partly based on a desire to most fairly scale benefits, as the Perry Preschool program is shorter in overall length, and thus the Perry Preschool's outcomes are perhaps more reasonably scalable to the shorter duration of CC and PCMC-A.

Direct Benefits

For both models, the estimates for benefits to participant earnings and decreased costs for K-12 education are based on the benefits of the Perry Preschool project (Belfield et al., 2006). Belfield et al determine that the effects of the Perry Preschool program led to \$79,743 of increased earnings and tax payments per student (Ibid). This

estimate is scaled to the length of the eight or 44-week intervention program to produce the estimates reported in the tables below. The costs of additional higher education received by program participants are similarly scaled for length and subtracted from the scaled income benefits, to correctly determine the overall net increase in earnings that participants experienced as a result of their participation in the Perry program.

Avoided Costs

A significant portion of benefits that have been analyzed in previous benefit-cost analyses of early education programs are avoided costs. These metrics include savings from government welfare payments that were avoided due to individuals' increased incomes, the avoided costs of criminal activity and incarceration of program participants, and avoided healthcare costs. In the following benefit charts, benefits expected to arise from decreased welfare dependence are scaled from results from the Perry Preschool program. Belfield et al. determine that participants in the Perry preschool, on average, received lower amounts of public welfare payments than the control group (2006). While these decreases may not amount to a remarkable dollar value when they are scaled to the degrees demonstrated below, they represent an important component of the societal benefits that high quality early childhood education programs can create.

The categories of benefits discussed thus far were demonstrated to be statistically significant in both the Perry and Abecedarian benefit-cost analyses. Benefits stemming from decreased rates of criminal activity were found only in the Perry Preschool study, and benefits arising from avoided healthcare costs, principally decreased rates of smoking, were found only in the Abecedarian program.

Barnett and Masse address the fact that their study does not find significant decreases in criminal activity for program participants in the Abecedarian preschool in their comparative analysis. Indeed, Barnett and Masse frequently compare the Abecedarian program to the Perry program, and compare their economic analysis to a previous study conducted on the Perry program (of which Barnett was a co-author) (Barnett and Masse, 2005). Barnett and Masse describe several hypotheses for this differentiation in results among preschool programs that have many demonstrably similar attributes. One possibility is that curriculum differences between the two programs led to this difference (Ibid). Schweinhart and Weikart discuss this possibility in a study of the Perry Preschool program conducted in 1997, and determine that it is possible for a preschool to produce cognitive improvements in children, yet not encourage social and emotional growth that can lead to decreases in behavioral health issues and criminal activity.

Schewinhart and Weikart state that the marked decreases they observed in misconduct, emotional disturbance, and felony arrests of students who participated in the Perry Preschool can be “attributed to the emphasis on planning, social reasoning, and other social objectives in the High/Scope curriculum” (1997). This study compared participants in the Perry Preschool to students who had attended a high-quality preschool for the same duration as the Perry students, meaning that the differences in criminal actions were not due solely to preschool attendance (Schweinhart and Weikart, 1997). The authors note that for a decade, there were no significant differences observed in the academic performance of students in these different programs, but that it was the traits of emotional control and decreased criminal activity, observed later in

life, that differentiated the Perry program participants from their peers (Ibid).

Schweinhart and Weikart emphasize the implied importance of teaching planning and social reasoning skills in the classroom, and discuss how encouraging the development of planning and initiative-taking skills in children contribute to their overall intellectual and emotional development.

Planning and encouraging consistency in both the classroom and home environment are central goals of the CC curriculum, and results of PCMC-A provide evidence that both the child and parent components of CC help to increase social-interaction skills and emotional maturity of the program's participants (Neville et al., 2013). There is thus a strong basis for hypothesizing that CC has the potential to create emotional improvements in its students that could lead to criminal behavior reductions, like those that occurred for the students involved in the Perry Preschool Project.

The other ameliorating factor that Barnett and Masse propose for why the Abecedarian preschool did not appear to create reductions in crime rates among its students is that in the location of the Abecedarian program there "simply was not much crime to prevent" (Barnett and Masse, 2005). Barnett and Masse continue to explain that the communities in Chapel Hill, North Carolina in which the Abecedarian students lived were fairly affluent, and Barnett and Masse additionally clarify that the community of Chapel Hill was "unusually responsive to the needs of their poorest members" (Ibid). The City of Chapel Hill additionally has substantially lower overall crime rates than Ypsilanti, Michigan (the setting of the Perry Preschool program); according to FBI crime reports, when the children involved in the Abecedarian program

were 15 years old, the crime rate in Ypsilanti was 70% higher than the rate in Chapel Hill (Ibid).

The city of Eugene, Oregon, the location of the trials of PCMC-A, and the location for initial implementation of CC, has a combined property and violent crime rate of 3.6155 per 100 individuals, as opposed a national average combined property and violent crime rate of 2.8596 per 100 individuals (FBI, 2015). Unfortunately, due to differences in national crime reporting standards, it is not possible to make a meaningful comparison between Eugene and Ypsilanti or Chapel Hill. However, given the fact that Eugene's overall crime rate is above the national average, and given the educational methodology reasons I have outlined above, I believe it is reasonable to utilize a scaling of the results from the Perry Preschool to estimate decreases in crime rates for CC. According to the methodologies already described, the estimated benefits resulting from crime avoidance are scaled to provide estimates for both scenarios of CC, with benefits estimated at a three percent discount rate.

Barnett and Masse, in their benefit-cost analysis of the Abecedarian Preschool program, found that their program participants were less likely to smoke than the control group (2005). In their analysis, Barnett and Masse determine that decreases in early mortality due to decreases in smoking alone account for 17,800 dollars of benefit per program participant at a three percent discount rate (Barnett and Masse, 2005). This metric accounts only for the benefits received from longer average lifespan of non-smokers, and does not account for increased costs of illness and healthcare for smokers.

According to statistics from the US Centers for Disease Control, smoking rates in the United States for both youth and adults have been declining steadily since the

1970's and 80's, the era in which the Abecedarian program participants were born and attended preschool (CDC, 2014). However, smoking rates in the United States, historically and currently, are much higher for individuals with lower incomes, as well as individuals with lower levels of education (CDC, 2014). As this is precisely the population that CC and Head Start are working to serve, I believe it is pertinent to consider the effects of decreased smoking rates for individuals who receive a high-quality preschool education. These effects can be viewed both as an indication of the benefits of decreased smoking rates, and more generally as an example of the potential for economic benefits arising from improved health.

The estimated benefits resulting from reductions in smoking rates from participants in the Abecedarian program are scaled in the same method described previously to obtain estimates of the benefits reasonable to expect from CC. These results of the Abecedarian benefit-cost analysis provide strong evidence of the improvements in the life-long health of an individual that a high-quality education can provide. Further, costs of diseases and illness are not born simply by the individuals who suffer from these misfortunes. Smoking-related health issues caused approximately 157 billion dollars in annual economic losses in the United States from 1995-1999, and these losses occur not only to individuals who smoke, but to society as a whole (CDC, 2002).

Table 4 shows the projected per-child benefits to be received from both forms of benefit projection discussed, separated by benefit category. As the results of the benefit-cost analyses of the Perry Preschool and Abecedarian Preschool are important to these estimates, the results of these studies are summarized in the appendix.

Benefit Category:	8-Week Scaling Assumption:	44-Week Scaling Assumption:
Increased Earnings:	\$ 11,853	\$ 65,193
Costs of Higher Education:	\$ (195)	\$ (1,070)
Decreased Costs of K-12 Education:	\$ 1,272	\$ 6,995
Decreased Welfare Reliance:	\$ 115	\$ 633
Decreased Smoking Rates:	\$ 761	\$ 4,187
Avoided Criminal Costs:	\$ 26,740	\$ 147,071
Total Per Child Benefits (Less Avoided Criminal Costs):	\$ 13,807	\$ 75,938
Total Per Child Benefits:	\$ 40,547	\$ 223,009

Table 4: Projected Benefits

All benefits inflation-adjusted to 2016 dollars, and estimated at 3% discount rate.

Discussion

The projected benefits and costs of CC implementation demonstrate compelling evidence that CC has the potential to create a positive economic impact, and result in a benefit-cost ratio (BCR) significantly greater than one. Tables 5 and 6 compare the BCRs of the program, given the three sizes of implementation, and the two sets of benefit projection assumptions. Table 5 corresponds to the eight-week scaling assumption, while Table 6 corresponds to the 44-week scaling assumption. As the estimated benefits from avoided criminal costs constitute a large portion of the overall projected benefits, BCRs are produced both with and without these benefits included, to give a better appreciation for the potential for positive benefit of the program, even disregarding avoided criminal costs.

8-Week Benefits Scaling:			
	Single Preschool:	Lane County:	State-Wide:
Avoided Crime Costs Not Included:	16.9	22.0	22.8
Avoided Crime Costs Included:	49.5	64.7	67.1

Table 5: Benefit-Cost Ratios Under PCMC-A 8-Week Benefits Scaling Assumption

44-Week Benefits Scaling:			
	Single Preschool:	Lane County:	State-Wide:
Avoided Crime Costs Not Included:	92.7	121.1	125.7
Avoided Crime Costs Included:	272.2	355.7	369.0

Table 6: Benefit-Cost Ratios Under 44-Week Benefits Scaling Assumption

One can observe from these tables that even under the most restrictive assumptions, CC has the potential to have a BCR of roughly 22:1 in the most likely scenario of county-wide implementation. This result implies that monies invested in CC would create large and effective economic improvements in the lives of the students involved in the program, as well as in the societies in which these children will grow up and live their lives.

The large increase in BCR that reductions in criminal activity can cause reflects two important points: that the benefits of children receiving enriching education early in life accrue to many individuals besides the child receiving that education, and additionally that even a small decrease in crime rates can create significant economic benefit. As emotional regulation and emotional development are core characteristics of the CC curriculum, it is likely that CC has the potential to foster long-lasting emotional growth in its students. Results of the Perry Preschool analysis and the curriculum analysis of Schweinhart and Weikart indicate the compelling crime-reduction outcomes of emotional and social-skills oriented preschool curriculums. I will assert, then, that the benefits expected to occur due to decreases in crime are representative of the broader social benefits that enriching childhood education programs create for a society.

Another significant indication of the results shown in the previous BCR tables is the fact that per-child program costs decrease significantly (increasing overall BCR) as the scale of CC implementation increases. Based on the proposed management structure of the BDL for a county-wide implementation of the CC curriculum in Head Start preschools, the program benefits from significant economies of scale. At the county-wide level, a small number of administrative staff could oversee the program

throughout the entire Head Start district, significantly decreasing the per-student overhead costs of program administration. While further cost decreases due to program integration into the regular operating costs of Head Start are not quantified in this study, the potential for this integration, leading to further long-term decreases in operating costs of the program, are most present in the county and state-wide implementation scenarios. These results also point to the conclusion that if student intellectual growth in the 44-week CC intervention continues to increase past the levels observed in the 8-week PCMC-A intervention – as the BDL researchers believe is likely to occur – the economic benefits of CC will increase greatly.

Sensitivity Analysis

Given that the results described previously produce a large and positive benefit-cost ratio for CC, it is important to examine what minimal amount of benefits would be required for the program to have a benefit-cost ratio equal to one. This approach is useful, as the benefits quantified in this projection are based on a number of presumptions, and one might question how significantly these assumptions impact the BCR's this analysis has produced. However, a sensitivity analysis supports the assertion that CC could create benefits only a fraction as large as the projected benefits estimated from the Abecedarian and Perry preschools, whilst still possessing a benefit-cost ratio greater than one. This result implies that even if some of the assumptions made in the benefit accounting do not hold, or some of the benefits do not manifest at the levels I suspect they will, CC still has the potential to be an economically productive social investment.

In Table 4, the projected benefits of CC are presented under the previously described assumptions that CC will create benefits proportional to the benefits observed in the Abecedarian and Perry Preschool studies. Under the assumption scaling benefits down to an eight-week program length (the more conservative restriction), the per-child benefits are estimated to be \$13,807 with benefits of reduced criminal activity excluded, and to be \$40,547 with the inclusion of benefits of reduced criminal activity. Given the per-child program costs of between \$604 and \$819 (presented in Tables 1-3), CC would only have to create benefits approximately five percent as large as my most conservative projections to produce a BCR greater than one. Table 7 shows the percentages of the benefits from the eight-week benefits scaling required for the BCR of CC to be one.

Implementation Scope:	Percentage of Eight-Week Benefits Required for BCR of 1 - Avoided Crime Benefits Excluded:	Percentage of Eight-Week Benefits Required for BCR of 1- Avoided Crime Benefits Included:
Single Preschool:	5.93%	2.02%
Lane County:	4.54%	1.55%
State of Oregon:	4.38%	1.49%

Table 7: Required Percent of 8-Week Scaled Benefits for BCR to be equal to 1

Table 7 demonstrates that for CC to produce benefits in excess of the costs of program implementation, participants in CC would only have to receive between four and six percent of the benefits we project they will receive under the most conservative eight-week scaling, excluding the benefits of avoided criminal activity. If one considers the eight-week scaling including the benefits of avoided criminal activity, this required

percentage of realized benefits falls to only 1.55 percent for the Lane County implementation scenario, providing further evidence that it is highly likely that CC has the potential to be an economically sound investment, which provides in excess of the cost of program implementation.

CC programming, in the scenario envisioned for this projection, would likely suffer from rates of parent attendance significantly below 100 percent. In current Head Start classrooms using CC, the BDL estimates that roughly 15 to 20 percent of parents are fully participating in the parent sessions of CC. It is possible that this lower level of parent participation would reduce the realized benefits of children participating in CC, however, as opposed to PCMC-A, in CC classrooms, teachers are utilizing parenting strategies in their teaching. Thus, pending future data on CC student outcomes, it is impossible to say definitively what effect parent attendance rates have on the overall intellectual and emotional outcomes of participants in CC.

In all aspects of this benefit-cost projection, I have attempted to make conservative assumptions, to provide a reliable estimate of CC benefits, while leaving open the possibility that benefits may in reality be greater than my estimates. For this reason, despite the likely possibility of not all parents attending CC parent sessions, all costs are calculated assuming that every family involved in CC attended all sessions and received all the relevant attendance incentives. In the implementation of CC into a new school or school district, it is likely that the costs of providing parent sessions could be scaled down significantly to meet the actual level of parent attendance, and these decreases in costs could perhaps counter a decrease in realized benefits even if child benefits are indeed found to decrease based on lower parent attendance rates.

The percentages in Table 7 should serve as an example of the high potential positive benefit that CC possesses, even if not all aspects of the program function in the manner that they are hypothesized to in this project. Rates of attendance at parenting sessions is an example of how a deviation from the hypotheses set out in this analysis might reduce the realized benefits of the program, but at the same time, lead to sizeable decreases in costs. These decreases in costs may partially or fully mitigate the benefit losses caused by these deviations. The percentage values from Table 7, then, should be taken as evidence that even if CC only creates a fraction of the benefits it is projected to, the program would still have the potential to be an effective tool for economic improvement.

Potential for Unaccounted Benefits

For the purpose of making a conservative and justifiable benefit-cost analysis, there are a number of potential benefits of CC that are not discussed or measured in the preceding analysis. These benefits, however, have the potential to be significant for the students receiving them, as well as the societies in which they live and work.

If early childhood education has the potential to improve individuals' lifetime health outcomes, tremendous benefits could be provided to society, realized in the form of decreased healthcare costs, increased years of productive life for individuals who have avoided chronic illness, and increased psychological well-being. A recent study by Campbell et al. examines long-term health indicators for cardiovascular and metabolic disease of Abecedarian program participants in their mid-30's. Campbell et al. utilize robust statistical methods (to compensate for small sample size) to determine that Abecedarian program participants, and male participants in particular, demonstrate

“significantly lower prevalence of risk factors for cardiovascular and metabolic diseases” (Campbell et al., 2014). This difference in overall cardiovascular health is quantitatively large – male participants in the program have average systolic blood pressures of 126 millimeters of mercury, as opposed to the mean pressure of 143 millimeters for male members of the control group (Ibid).

This study is a compelling discussion of the impacts of education on long-term health benefits. Following the earlier determination that Abecedarian program participants smoked at lower rates than members of the control group, the research published by Campbell et al. indicates that high quality education could impact health outcomes of individuals in systemic ways (Ibid). While researchers have postulated that higher-quality education might enable individuals to make better decisions about their health, seek appropriate medical care, and better manage illness and disease, until recently this theory lacked significant scientific evidence. The work of Campbell et al. is a strong indication for the potential for lasting health benefits occurring as a result of early childhood education, well into students’ adult lives.

Suggestions for Future Research and Limitations of Analysis

There are several limitations of this research, most notably the lack of long-term data regarding PCMC-A participants. The shorter operational length of this program, however, is encouraging, as it demonstrates that there are talented and determined individuals working to improve the systems of early childhood education in this country. The members of the BDL are making current and continuing progress in their work, which makes it all the more important to obtain early analysis of the outcomes of CC, even though an optimal set of data for this type of analysis may not yet be available. Given this data restriction, this benefit-cost analysis does rely strongly on the legitimacy of comparability between CC, the Perry Preschool project, and the Abecedarian project. The comparisons drawn between these programs are necessary, however, for the purpose of this analysis.

Based on the quantitative intellectual and emotional growth that Neville et al. have demonstrated in their research, as well as the studies of BDL programs conducted by Yaillen & Blair and Pierce & Rao, I have used the cross-program comparisons drawn in this thesis, as I believe that these results constitute fair estimators of the long-term benefits of CC. I fully acknowledge that some might disagree with some of the underlying benefit assumptions used in this project, which was an influential factor in constructing multiple benefit estimates. I would point out that even under the strictest of conditions imposed on both the benefit and cost estimations, CC is evidenced by this analysis to have a benefit-cost ratio of 22:1 for the Lane County implementation scenario. Even given disagreements about the precise validity of certain categories of

benefit estimation, I believe it is important to acknowledge that this outcome represents a compelling case for the economic effectiveness of this program.

In CC, it was previously discussed that Brain Train activities and other student programming are integrated into the Head Start Curriculum, and delivered to students continuously throughout the 44-week Head Start academic year. This is in contrast to the structure of PCMC-A, where child sessions took place outside of, and in addition to, the normal Head Start school day. It is worthy of note that this integration of Brain Train into the school day is possibly taking some small amount of time away from Head Start curriculum as it was taught prior to the implementation of CC. This issue runs counter to the research proposal of analyzing the marginal benefits and costs of CC, as compared to Head Start, as the Head Start programming to which we are comparing is slightly modified. However, after consultation with my advisors, I do not believe that this issue represents a detriment to the analysis previously described, due to the rather small impact it is theorized this shift has on the overall educational experience of children participating in CC. Further, the intervention length increase of eight to 44 weeks between PCMC-A and CC may make up for any minimal educational losses due to the change in Head Start programming. In the spirit of transparency, I merely wish to acknowledge that this unfortunate circumstance does exist, although I do not believe that a small decrease in Head Start instructional time makes more than a negligible difference to the benefit-cost projections laid out previously.

Future research examining the economic impacts of CC could benefit from the opportunity to examine longitudinal data on student performance and life outcomes following involvement in PCMC-A, or further in the future, from the use of longitudinal

data following CC participants. If CC is expanded throughout Lane County, it would be optimal if all costs of the program were documented, in order to have a complete accounting of program costs for future analysis. Data pertaining to student performance and costs of a Lane County-wide version of CC would additionally create the potential for a better-founded analysis of wide-scale implementation scenarios, including CC expansion into other counties or throughout the state of Oregon. Ultimately, it would be optimal to have a body of data pertaining to student academic, emotional, and life experiences, as well as program costs, that would enable a professional economic analysis of CC. A benefit-cost analysis of the quality and scope of the work done on the Abecedarian and Perry preschools would provide the most accurate insights into the long-term benefits and costs of CC, and could perhaps help inform public policy pertaining to funding and structure of Head Start and other early childhood education programs.

Conclusion

Given the evidence from research into the challenged life and academic outcomes of lower socioeconomic status children, the importance of improving the economic and academic potential of at-risk young children is apparent (Hackman et al., 2010, Neville et al., 2013). Children who participate in Head Start preschools are a subset of this vulnerable group of children for whom a high-quality education could present an opportunity for long-lasting life improvement. Based on research findings regarding the development of young children's brains, CC is designed to provide children the opportunity for important emotional and cognitive growth that has the potential to positively impact their lives in numerous ways.

Findings from PCMC-A published by Neville et al. in 2013 show that it is possible to create significant improvements in children's cognitive and emotional abilities over a short period of time, with relatively low intervention costs (Neville et al. 2013). These improvements have the potential to be increasingly important for children of low socioeconomic status, as children from these backgrounds have been discussed in previous research to be particularly susceptible to academic challenges and poor scholastic performance (Ibid).

As long-term follow-up data for participants in PCMC-A are not yet available, this thesis constructs estimates of the longer-term economic benefits that program participants can expect to receive, based on comparisons to the Perry Preschool program and the Abecedarian program. Estimates of implementation costs for CC are made using salary and other cost information for Head Start of Lane County.

The results of the benefit and cost predictions of this study imply that CC has a strong potential to create significant economic benefits for the intervention's participants, with the program resulting in a benefit-cost ratio of roughly 22:1. These benefits, it is important to note, are projected to provide notable societal benefits in addition to the individual economic benefits realized by program participants.

Additionally, this study implies that CC has the potential to benefit from decreasing per-student costs as the scale of the program is increased, such that a county or state-wide implementation of the program has the potential to further decrease per-child costs of the program, and further increase the BCR of the program. The benefit and cost predictions discussed are further constructed to represent the immediate cost of implementing these curricular changes in Head Start preschools, however, in addition to the decreased costs incurred from larger-scale implementations of the program, there is further potential that long-term integration of the Creating Connections program into the broader structure of Head Start could lead to further decreasing program costs over time. The Creating Connections program is therefore determined to represent a highly economically productive means of fostering intellectual and emotional growth and development of at-risk children.

Appendix

Table 8: Summary of Benefit from Abecedarian and Perry Preschool Programs

	Abecedarian Program Benefits:	Perry Preschool Benefits:
Earnings of Student	\$ 50,208.97	\$ 106,680.19
Earnings - Future Generations	\$ 7,654.89	
Earnings - Maternal	\$ 91,944.32	
Money saved on K-12 Education	\$ 11,820.80	\$ 11,446.22
Benefit from decreased smoking	\$ 23,787.42	
Costs of higher education	\$ (10,873.64)	\$ (1,751.18)
Welfare Savings	\$ 262.21	\$ 1,035.46
Decreases to Crime		\$ 240,662.36
Total Benefits per Child:	\$ 174,804.97	\$ 358,073.03

Results from Barnett and Masse, 2005, and Belfield et al., 2006. All benefits estimated at 3% discount rate, and inflation-adjusted to 2016 US Dollars. A blank value indicates that a study did not report a benefit value for that category. See discussion of benefit construction for more details.

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