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RESEARCH ARTICLE

## Early Childhood Education that Promotes Lifelong Learning, Health, and Social Well-being: The Abecedarian Project and its Replications

\***Craig T. Ramey, PhD**

Distinguished Scholar and Professor, Fralin Biomedical Research Institute; Departments of Psychology, Neuroscience, and Human Development, Virginia Tech

**Sharon Landesman Ramey, PhD**

Distinguished Scholar and Professor, Fralin Biomedical Research Institute; Departments of Psychology, Neuroscience, and Human Development, Virginia Tech

\***Corresponding author:** [slramey@vt.edu](mailto:slramey@vt.edu)

ABSTRACT

**Introduction:** The Abecedarian Project was a randomized controlled trial (RCT) that tested the effects of 5 years of early education combined with social and health supports on learning and cognitive development in infants from high-risk environments. This article provides a reflective review of its key findings from 50 years along with results from variations also tested in RCTs.

**Methods:** The Abecedarian Project and its replications all used a comparative efficacy RCT design. The Early Education treatment group received systematic early education with pediatric health care, early nutritional enhancement, and family social services while the Health/Social Services comparison group received health and family supports but not the formal early education program. In childhood, key outcomes were cognition and school-age academic achievement; in adulthood, assessments included post-high school educational attainment, employment, income/assets, adult family relationships, brain development, and social decision-making.

**Results:** At all tested ages after 12 months of age, the Abecedarian Early Education was associated with significant benefits in children's cognitive development, school and educational achievements, and multiple indicators of positive health and indicators of adult social adjustment. Collectively, the major replication studies provide affirmation of the positive impact of high-quality early education, although the breadth and magnitude of benefits vary with the child's environmental risks and dosage of the early education intervention. Some unexpected long-term associations include enhanced caring and future planning in social decision-making, positive relationships with parents, altered brain structure, and improved cardiovascular health.

**Conclusions:** This series of RCTs improved developmental trajectories of infants born into multi-risk social, economic, and biological life circumstances, thus strongly resolving that human malleability is achievable. The challenge ahead concerns how to effectively disseminate and practically use these findings to realize widespread benefits. We nominate both a guiding conceptual framework to help plan and measure strategic interventions as well as a set of hallmarks associated with successful community implementation of effective child and family programs.

**Keywords:** Early childhood education, high risk infants, poverty effects, Abecedarian Project, low birthweight, childcare effects, cognitive development, Project CARE, health benefits, return on investment, treatment-induced neuroplasticity, Infant Health and Development Project, academic achievement

## Introduction to The Abecedarian Approach to Early Childhood Enhanced Care and Education

Some questions about human development can only be answered by conducting randomized controlled trials (RCTs) that permit careful control over the experiences of children and their families. The compelling question is “Can the course of human development be significantly and practically altered by intentional and directed acts beginning early in development?” If so, then which systematic interventions produce meaningful and enduring benefits for children from low resource circumstances?

The question of human malleability has a long and controversial history. Opinions have deep philosophical, religious, and societal origins. Unsupported and influential racial and social class assumptions continue to shape policies in education, housing, health care, employment, and all aspects of family life. One dominant and tragic assumption held that certain groups are pre-determined to lead lives of “lesser” versus “better” value to society. Importantly, this societal view of fixed differences always had strong, vocal, and sometimes effective challengers. Not surprisingly, the arena of scientific inquiry about human development often mirrored the philosophical and public policy debates, civil conflict, and social justice initiatives in the U.S. and throughout the world.

Scientists contributed to this well-known 19<sup>th</sup> and 20<sup>th</sup> century nature-nurture paradigm. Proponents of the unalterable genetic views, including Galton,<sup>1</sup> Jensen,<sup>2</sup> and Herrnstein and Murray<sup>3</sup> often relied on inadequate, distorted, or even sometimes falsified data. In contrast, among those favoring an environmental and experience-dependent viewpoint – prominently pursued in the 1960s – were Hunt<sup>4</sup> and Bijou and Baer.<sup>5</sup> They and many others provided examples of how the environment could influence how well children performed on standardized cognitive tests and real-world indicators of academic achievement and income. What was clear in the 1960s was the need to conduct ethical experiments to resolve this longstanding, vigorous controversy. Stated differently, no amount of sophisticated and detailed statistical analyses of naturalistic, longitudinal studies of children could answer the question of what causes differential life courses. Rather, experiments could uniquely answer this question of whether receiving a package of essential resources, starting at birth, could lead to improved cognitive, social-emotional, and health outcomes. The essential resources included individualized high-quality pediatric health care,

infant nutrition, and family social services; further, early childhood education in the form of stable, warm, responsive care and fun learning and language interactions comprised a promising “additional essential” for young children to thrive. Accordingly, we chose these essentials to manipulate via RCT studies, thus permitting a rigorous test of their impact on human health and development.

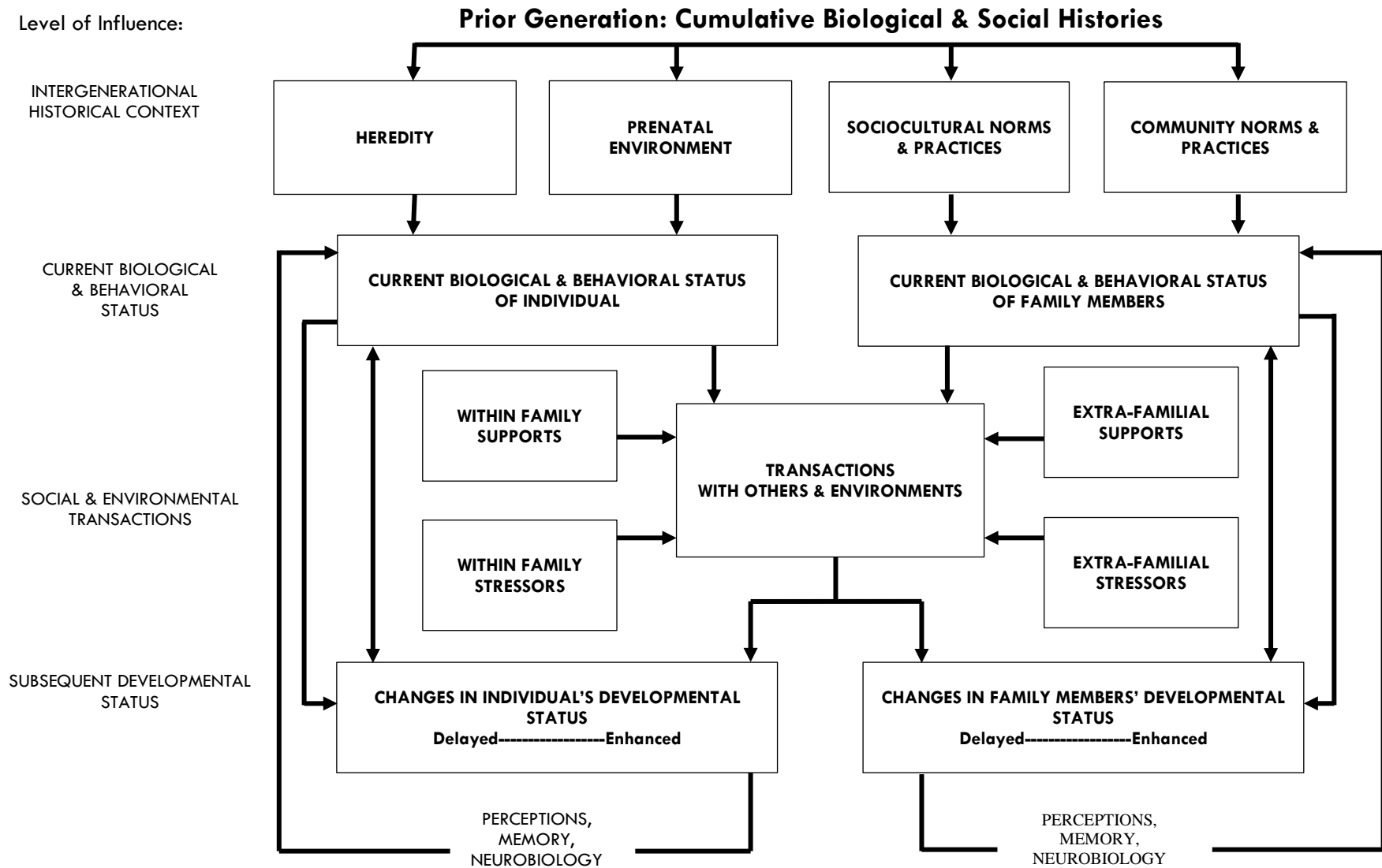
Children who meet criteria for being “at risk” for non-optimal development often come from families and communities that have endured deprivation due to societal policies and practices that marginalize, devalue, and directly harm entire groups of individuals. Even in the early 1970s when the Abecedarian Project began, there was abundant evidence that intergenerational economic poverty, regardless of race or ethnicity, was powerfully linked to poor outcomes in school readiness, school achievement, and adult health and well-being.<sup>6</sup> More recent findings show that growing up in poverty is associated with measurable differences in adult brain structure,<sup>7</sup> findings consistent with experimental animal studies of early enrichment versus deprivation<sup>8</sup> and worldwide crises of early childhood maltreatment, such as occurred in the Romanian orphanages under oppressive national policies.<sup>9,10</sup>

## The Biosocial Contextual Systems Framework: An overview of the ideas that shaped the Abecedarian Project

We have organized the key ideas about influences on early human development into a conceptual framework<sup>11-13</sup> that builds on formal biological systems theory, measures nearby and distal ecological influences, incorporates the paradigm-challenging findings in the 1960s and 1970s from our labs and others’ about infant learning.<sup>e.g., 14-15</sup>

**Figure 1, The Biosocial Contextual Systems Framework**, illustrates the key ideas or constructs in this framework. This emphasizes the importance of multiple types and levels of influences co-occurring. An individual’s course of development is directly influenced by conditions that begin before conception and birth, as shown in the top row of the figure. The figure’s central box labelled “Transactions with Others & Environment” identifies the most important driving force for an individual’s development. Adjacent boxes are the “Supports and Stressors” that occur “Within Family” and in “Extra-Familial” contexts. In turn, the transactions produce complex changes in both the biology and behavior of the individual, as well as in the child’s family members. Figure 1 shows feedback loops and examples of how human development is dynamically shaped.

**Figure 1.** Biosocial Contextual Systems Framework (adapted from Ramey & Ramey, 1998)<sup>12</sup>



This conceptual framework points to the necessity of identifying which aspects of “Transactions with Others & Environments” and which environmental stressors and supports should be manipulated (i.e., improved) and measured. Specifically, the Abecedarian Project provided a multi-component treatment package designed to improve the child’s daily transactions via the Abecedarian Early Education intervention and delivered to both groups an increased package of external supports and stress reducing strategies for children for both treatment groups.

This intergenerational and practical framework emphasizes changes in both children and their families.<sup>12</sup> This framework has helped guide the selection of intervention strategies, outcome measures, and data analytic approaches. Within this framework, the “Current biological and behavior status” of children and adults corresponds to data we collect at each timepoint on study participants. These repeated assessments help capture the cumulative effects of the treatments being tested. Because an RCT is a study design in which treatment groups are created by an equitable process – that is, random assignment with parent permission and engagement – the influences of genetics, the prenatal environment, sociocultural norms and practices, and special characteristics and resources of local communities are assumed to be similar, on average, across the treatment groups.

Within this general conceptual framework, for the Abecedarian Project and its replication RCTs known as Project CARE and the Infant Health and Development Program, we developed a systematic, written early childhood education curriculum or program that was delivered by trained “teachers” (a mix of adults with relevant content expertise, coming from the children’s immediate neighborhoods and the larger community). These three RCTs have been archived by the Eunice Kennedy Shriver National Institute of Child Health and Human Development for public availability, and described in the companion book “*Abecedarian: The Ideas, the Approach, and the Findings*” by Ramey, Sparling, and Ramey.<sup>16</sup> More recently, Sparling, Ramey, Meunier, and Ramey<sup>17</sup> wrote “*The Abecedarian Approach to Healthy Development*” to provide a shorter, practical overview of the early education intervention. The Abecedarian Approach refers to the training and specific educational materials used within an

organized educational childcare setting that we designed and operated. The key areas emphasized in the educational transactions involved activities grouped under four pillars: 1) language priority, 2) conversational reading, 3) specific “learning games” appropriate for the child’s developmental readiness, and 4) enriched caregiving throughout the day. We hypothesized that early experiences impacted neuroplasticity, such as neurotransmitter changes (e.g., serotonin and dopamine levels and the endorphin systems), synaptic pruning as a function of experience (particularly use-dependent neural network development), and gene activation/deactivation associated with experiences although technologies for documenting these changes in young children did not exist at the time.<sup>18,19</sup>

In 1999, we wrote “*Right from Birth: Building Your Child’s Foundation for Life*”<sup>20</sup> and “*Going to School: How to Help Your Child Succeed*”<sup>21</sup> that provided a synthesis of “Transactions with Others & the Environment” for young children. Consistent with more than 1000 peer-reviewed scientific papers about early learning and brain development, we identified a set of 7 distinctive social interaction activities, displayed in Table 1. These learning essentials can assist adult care providers and teachers focus on activities known to promote cognitive and social-emotional maturation. These books were the companion guides for two Public Broadcast System (PBS) television series; together, the books and televised episodes provided core materials for implementing several large-scale, community-based programs that successfully enhanced both parenting as well as early childcare and education services in multiple states.

### **The Three “Abecedarian Approach” Randomized Controlled Trials (RCTs)**

The Abecedarian Approach was tested in three longitudinal projects – two single-site and one multi-site randomized controlled trial (RCT) involving 1160 children and their families. The Abecedarian Approach assumes children are learning all the time. Thus, the Abecedarian enhanced childcare and early education program was designed to be highly engaging, fun, and active - for both children and the adults - with learning activities occurring naturally throughout the day during caregiving, physical play, exploration, and structured interactive learning games.

**Table 1.** *Essential Transactions for Early Learning and Cognitive Development, From Ramey and Ramey* <sup>20,21</sup>

<b>1. ENCOURAGE</b>
Encourage exploration with all the senses, in familiar and new places, with others and alone, safely and with joy.
<b>2. MENTOR</b>
Mentor in basic skills, showing the whats and whens, the ins and outs of how things and people work.
<b>3. CELEBRATE</b>
Celebrate developmental advances, for learning new skills, little and big, and for becoming a unique individual.
<b>4. REHEARSE</b>
Rehearse and extend new skills, showing your baby how to practice again and again, in the same and different ways, with new people and new things.
<b>5. PROTECT</b>
Protect from inappropriate disapproval, teasing, neglect, or punishment.
<b>6. COMMUNICATE</b>
Communicate richly and responsively with sounds, songs, gestures, and words; bring your baby into the wonderful world of language and its many uses.
<b>7. GUIDE</b>
Guide and limit behavior to keep your child safe and to teach what's acceptable, and what's not — the rules of being a cooperative, responsive, and caring person.

The educational curriculum was based on known types of learning processes in infants, toddlers, and young children, such as described by Ramey, Breitmayer, Goldman, and Wakeley.<sup>22</sup> Learning activities were paced to be appropriate for each child's development so each child had a mix of new challenges along with practice of skills recently acquired to advance their levels of mastery. The Abecedarian Approach underlined the centrality of child-adult communication for optimally advancing cognition and intelligence.<sup>23-25</sup> Accordingly, planned activities included many ways to use pictures, signs, symbols, sounds, words, sentences, stories, toys, everyday objects, and interactive conversations - starting early in the first year of life. Even conversational reading and play began in the first 6 months of life with specially written picture/word books. Teachers were skilled in using varied, complex, and informative language throughout the day.

A brief description of three independent RCTs and their study participants follows:

- *The Abecedarian Project.* The sample consisted of 111 economically poor families in greater Chapel Hill, North Carolina who had at least several risks (e.g., teen mother, did not complete high school, mental health/substance abuse problems, lack of social supports, low tested IQ). Almost all (98%) were Black/African-American (this was not

considered a risk condition), 76% were single-mother households with an average maternal education of 10th grade and a mean tested IQ of 84 points, approximately 1 standard deviation below the national average of 100. The two treatment groups provided 1) an enhanced Health/Social Services group (the comparison group) and 2) the Abecedarian Early Education group that added 5 years of a center-based childcare and systematic educational program to the package of health and social supports. Table 2 summarizes the key components of the birth to 5 year old treatment groups.

- *Project Carolina Approach to Responsive Education (Project CARE).* The sample included 64 economically poor, high-risk families in the same area of North Carolina as the Abecedarian Project. The children were randomly assigned to one of the same two treatment groups in the Abecedarian Project (Table 2) or a third treatment group that provided a new version of the Abecedarian Approach for parents to provide at home for their own children. This new Home Visiting Education group had trained home visitors who provided toys, books, and supplies and active instruction to parent in how to deliver the Abecedarian Approach for the first 5 years of the child's life.

**Table 2.** The Abecedarian Project: Comparison of the Abecedarian Early Education plus Health/Social Services and the Health/Social Services treatment groups

Abecedarian Early Education plus Health/Social Services	Health/Social Services
<ul style="list-style-type: none"> <li>• Adequate nutrition</li> <li>• Supportive individualized family social services</li> <li>• Low-cost or free primary health care</li> <li>• Transportation</li> <li>• Responsive Care and Early Childhood Education:                Intensive (full day, 5 days/week, 50 weeks/year, 5 years)                Abecedarian Approach learning games, conversational reading, language priority, &amp; enriched caregiving                Individualized pace</li> </ul>	<ul style="list-style-type: none"> <li>• Adequate nutrition</li> <li>• Supportive individualized family social services</li> <li>• Low-cost or free primary health care</li> <li>• Transportation</li> </ul>

- *The Infant Health and Development Program (IHDP).* The sample enrolled 985 premature (<37 weeks) and low birthweight infants (<2500 gm) from 8 cities. The families were not selected based on income or demographic risk variables, but rather solely on their child being premature and low birthweight. Families spanned a wide range of income and parental education groups: 38% were white/non-Hispanic, 51% Black/African-American, and 11% Hispanic/Latino. Notably, the treatment for the Infant Health and Development Program occurred only during the first 3 years of life, because these early years seemed crucial and there appeared to be many good community options for preschool programs for 3- and 4-year olds, including those from low-income families. The two treatment groups were 1) Enhanced Health and Social Services group, highly similar to the original Abecedarian Project, with reasonable adjustments based on the infants' prematurity and low birthweight conditions, and 2) an Early Education Group that provided an intensive home visiting program in the first 12 months of life (with continued visits to age 3) followed by the child attending a Child Development Center (specially developed and staffed for this study) that delivered an almost identical enhanced childcare and educational intervention used in the Abecedarian Project.

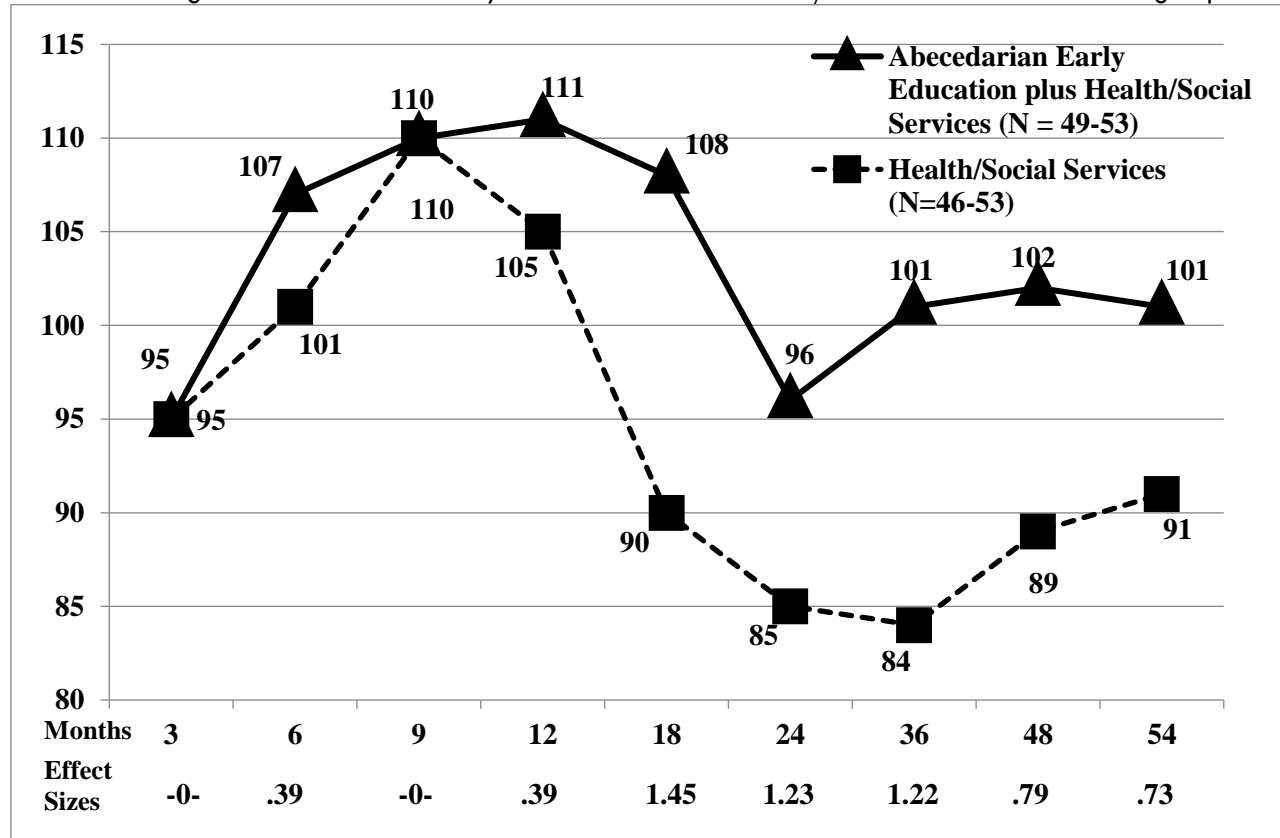
### Major Findings from The Abecedarian Project: From Birth to Kindergarten Entry (age 5)

The Abecedarian Project was conducted by a large multidisciplinary team of investigators. In this overview, we highlight two major types of findings – first, those that addressed the compelling question about the malleability of children’s cognitive and academic outcomes; and second, those that provide insights into how early experiences might “get under the skin” and influence other aspects of the human life course. We emphasize that all of the standardized assessments were administered by trained assessors who had nothing to do with the treatment of the child or family.

Figure 2 summarizes findings about developmental and cognitive outcomes in the first 54 months of life. During the first 12 months of life, children in both groups performed similarly with mean scores close to the national average of 100. Starting at 18 months, however, scores of children in the Health/Social Services group declined sharply and differed significantly from the Abecedarian Early Education group. By this age, those who received the educational intervention earned average scores of 108, 18 points higher than those in the Health/Social Services group (mean = 90). Significant group IQ differences of at least 10 points continued until the children were 4 ½ years old, the last age assessed prior to entering kindergarten.<sup>26</sup>



**Figure 2.** The Abecedarian Project mean scores on standardized tests of development/cognition from 3 to 54 months of age: The Abecedarian Early Education\* and the Health/Social Services\*\* treatment groups



\*The Abecedarian Early Education group received full-day enhanced child care and early childhood education from infancy through kindergarten at a university-based child development center for 5 days/week X 50 weeks/year. Children and families also received 5 years of stable social services and pediatric care for their children.

\*\*The Health/Social Services group received 5 years of stable and individualized family social services and pediatric care for their children. Additionally, families could choose community child care and preschool education for their children. Children whose scores fell within the range of “clinical concern” at any assessment were referred for in-depth clinical assessment and follow-up treatment if needed.

In the fields of education and pediatrics, effect sizes of 0.25 and higher are widely accepted as sufficient for guiding policy and practice. In the Abecedarian Project, the effect sizes from 18 through 36 months were exceptionally high – from 1.22 to 1.45 (shown on the bottom line of Figure 2). Interestingly, the effect sizes remained high – but somewhat less so – when children were 48 and 54 months of age. Figure 1 indicates that between 3 and 5, children in the Health/Social Services group had modest increases in IQ scores. We were able to link these increases to the fact that about half of these children participated in community preschool programs. Even more specifically, whether or not the child attended a child development center for at least one or two years in the community significantly increased their IQ scores.<sup>27</sup> We noted that the community child development centers in Chapel Hill, NC were mostly rated as high quality and well-staffed. Within the conceptual framework presented above, this finding of a bimodal

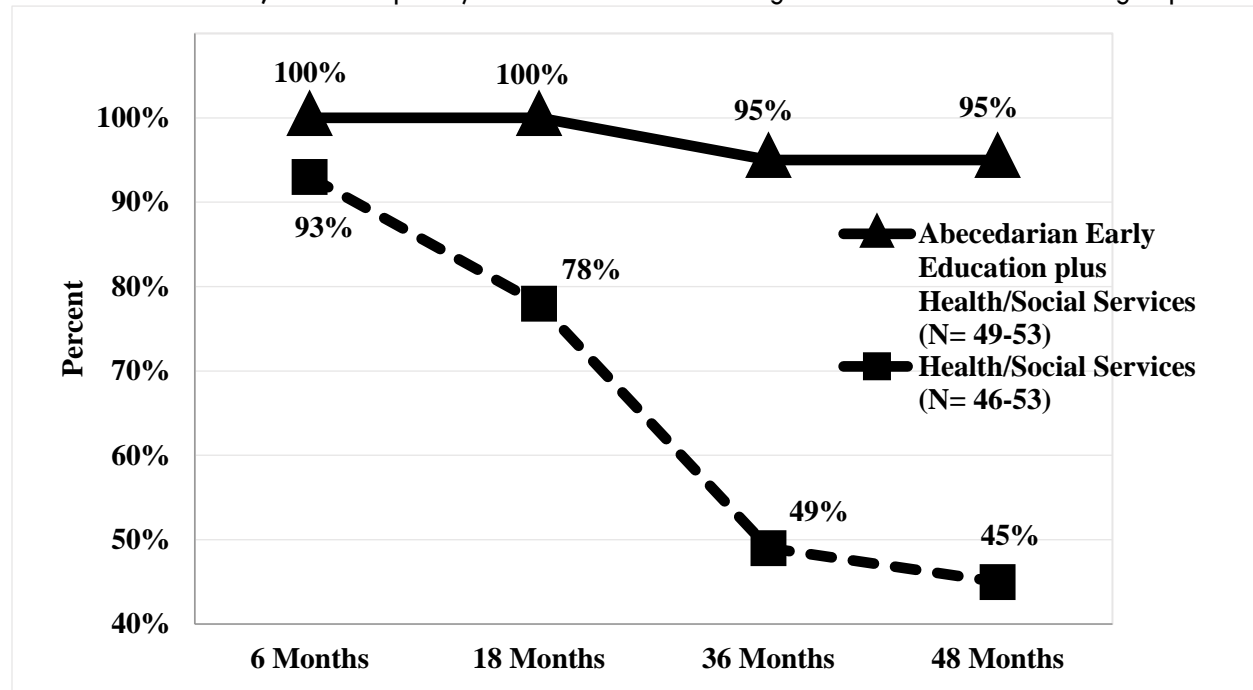
divergence *within* one of the treatment groups provides another source of evidence (observational rather than experimental) that receiving high-quality childcare and early education confers measurable benefits for children’s cognitive development and school readiness.

A clinical perspective on these test scores offers other insights. Figure 3 shows the percentage of children in each group who scored in the normal range of intelligence (i.e., earning IQ scores of 85 or higher on tests that have a national average of 100 and a standard deviation of 15 or 16) from 6 months to 4 years. The findings are as follows<sup>28</sup>: for the Health/Social Services group, 93% were in the normal range at age 6 months, but this dropped precipitously and continuously through age 4 when less than half of these children (45%) had IQ scores of 85 points or higher. This finding is consistent with a cumulative environmental toll hypothesis that insufficient cognitive, language, and social learning

opportunities cause young children to show marked delays in their cognitive growth. In marked contrast, for children in the Abecedarian Early Education group, 95 to 100% continued to score in the normal range (IQ scores of 85 to 115 and above) at all ages. This pattern of consistent and large group

differences supports the enrichment hypothesis that receiving individualized, systematic high-quality early education and warm, responsive childcare can prevent cognitive declines and clinically low IQ scores among children from very high-risk families living in poverty.

**Figure 3.** The Abecedarian Project: The percent of children who scored in the normal IQ range (>84 points; national mean = 100, s.d. = 15 points) from 6 to 48 months of age as a function of treatment group



### Maternal Outcomes and Mother-Child Interactions

We examined mothers' educational advancement, employment, and transactions with their children at multiple timepoints. Key findings<sup>29</sup> include the following: significantly more mothers in the Abecedarian Educational treatment obtained post-high school formal education than those in the Health/Social Services group; teen mothers showed the largest benefits with 80% eventually completing post-high school education compared to only 28% whose children did not receive the Abecedarian Early Education treatment; and maternal employment for adult mothers was 84% in the Abecedarian Educational group compared to 74% in the Health/Social Services group. Once again, these maternal benefits were even greater for teen mothers: 92% vs 66% employed when their child was age 15.

Important to remember was the national and local context for the Abecedarian Project. In the 1970s, center-based infant and toddler care in the community was rare, mothers often stayed home full-time, relatives frequently helped informally with

infant and child care, and many pediatricians cautioned that the mother-child bond might be harmed by strangers caring for very young infants. So, we carefully measured the mother-child relationship. We documented that the quality of the mother-child attachment (assessed via a standardized lab protocol) did not differ between the treatment groups, affirming that early group care did not harm or disrupt a positive mother-child bond. Further, within each treatment group, the mother-child dyads that had more frequent, warm, and positive scores predicted better cognitive outcomes for the children. Finally, for children in the Abecedarian Early Education group, they showed increased skills compared to those in the Health/Social Services group in being able to elicit positive and prompt responses from their mothers. This was an unexpected finding – revealing that when children consistently received high-quality enhanced childcare, they came to expect to receive high levels of positive responsiveness from their mothers as well.<sup>30-32</sup> These findings about improving mother-child interactions relate to the conceptual framework for the Abecedarian Project by demonstrating that the child's "Transactions with Others and Environments" (Figure 1) leads to



“Changes in Family Members’ Developmental Status” and, later, alters the “Current Biological and Behavioral Status of Family Members.” For us, these findings are captured vividly through an anecdote when we conducted the Fifth Decade Abecedarian Follow-up: a mother shared with us her story about what she learned from the Abecedarian Project. She told us she had been a very young, inexperienced mother, often angry and allowing her anger to spill over into how she treated her young child. Her child was in the Abecedarian Early Education group. One day after she was very upset with her child, the child asked “Why don’t you treat me nice like the teachers do every day?” She took that to heart, and began to change how she treated her child, noticing that their relationship improved a lot. Then, many years later she served as a mentor to her daughters-in-law, telling them her own story of being overly harsh as a mother, but learning firsthand that being patient and kinder to her child made both of them much happier. This mother told us we had helped everyone in her family.

We also frequently measured the quality of the child’s home environment, through direct observations and scoring via a standardized home assessment tool. The home environments – which the treatments did not directly try to change – were highly similar in the two groups; and, as shown by others, the measured quality of the home environment significantly related to children’s cognitive performance.<sup>28</sup> Once again, this finding supports the guiding conceptual framework about multiple, co-occurring influences. Even when a planned early intervention RCT, such as the Abecedarian Approach, proves to be associated with large and enduring benefits, the treatment does not change the fact that there are other strong and significant influences that co-exist in the child’s life – both positive and negative.<sup>28</sup>

## Replication RCTs: Findings from Project CARE and The Infant Health and Development Program in The Early Years

A hallmark in science is replicability of findings. The Abecedarian Project was replicated with variations, as described above. Here we summarize similarities and differences in the measured effects of the Abecedarian Early Education treatment compared to the other tested treatments.

Project CARE. Project CARE<sup>33,34</sup> was the closest study ever conducted as a true replication of the Abecedarian Project. We did add a third treatment group – the Home Visiting Education Group – to find out if parents could learn to provide the early

education in their own homes. Home Visitors went once a week until children were 3 years old to establish close relationships with the mothers and guidance in how to provide the pillars of the Abecedarian Approach. Then from age 3 to kindergarten, home visits continued with a schedule adjusted to meet parental preference. Mothers were given supplies, games, books, and toys to support the home-based curriculum. Findings from Project CARE showed that at 6 months of age and at all subsequent assessment ages, children in the Abecedarian Early Education group performed significantly higher than those in the Health/Social Services group. Further, the magnitude of these group differences closely replicated those in the Abecedarian Project. Quite unexpected, however, was that the Home Visiting Education treatment did not show any advantage above the Health/Social Services group. This was particularly disappointing because the families were highly participatory in the home visiting program, the mothers reported they liked and benefited from the home visits, and the home visitors also had positive appraisal of this treatment approach. We originally predicted that the Home Visiting group would show significant benefits, perhaps falling in-between the performance of children in the child development center where they received the curriculum from qualified, actively supervised teachers and assistants and those in the Health/Social Services group. To find no benefits from home visiting led us to think more carefully about the “dosage” of the “Transactions with Others & Environments” hypothesized in the guiding conceptual framework (see Figure 1 above). Thus, we speculated that even when mothers reported learning much from the home visiting program, they still may have been less adept and consistent (for a myriad of reasons) or may have had less time and energy to provide the equivalent of a full 8 hours/day, 5 days/week, 50 weeks/year of professional educational caregiving. As we report below, however some of the international RCTs using the Abecedarian Approach and parent education - in quite different contexts and conducted many decades later - did result in measured benefits for both children and parents.<sup>17</sup>

The Infant Health and Development Program (IHDP). IHDP<sup>35,36</sup> focused on the malleability of infants born prematurely and low birthweight, who generally are at elevated risk for developmental delays and lower cognitive and academic achievement. This study thus tested the generalizability of findings about the Abecedarian Approach to a clinical group of at-risk infants. The treatments provided were shortened to just the first 3 years of life, with the rationale that this

encompassed a sensitive developmental period for these biologically vulnerable children. We tested the treatments in 8 cities, providing a wide range of community contexts, population demographics, and extra-familial supports and stressors. Because the study enrolled a large number of infants and families, we were able to treat each site as an independent test of the Abecedarian Early Education treatment to produce significant benefits.

IHDP results replicated many of the Abecedarian Project conclusions about the first 3 years of life. First, we succeeded in building child development centers in the community and providing staff with the training and active supervision in how to deliver the Abecedarian Approach at high levels of fidelity to the original program in all 8 sites. We did find, however, that some sites required more intensive supervision and additional supports as they launched the program than did other sites. Second, in all 8 cities, the children in the early education treatment group had significantly higher mean IQ scores at both 24 and 36 months of age than did those in the Health/Social Services treatment group. Overall, the early education treatment conferred a combined site benefit of 10-plus points on average – highly similar to findings from the Abecedarian Project and Project CARE more than a decade earlier. Third, because IHDP had a much larger number of children from a wider range of both biological and environmental risk conditions than those in the Abecedarian Project and Project CARE, we were able to test for differential effects associated with infant risk (specifically, their birthweight category) and family risk (specifically, maternal education). Further, for the first time ever within an RCT, we were able to test for a significant relationship between child cognitive outcomes and the actual “dosage” each child and family received of the Abecedarian Early Education intervention. We expand on these differential effects below.

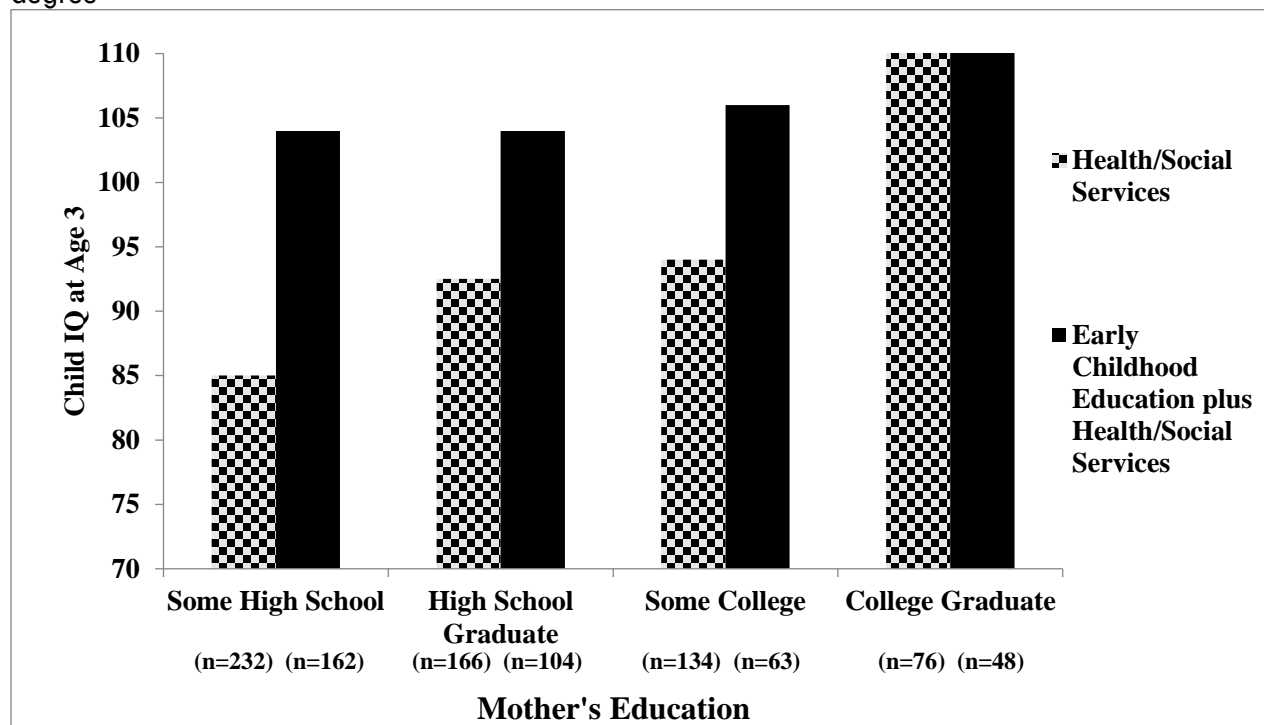
Differential effects in IHDP of the Abecedarian Early Education treatment as a function of child and family risks and participation levels. Concerning the role of infant biological risk at birth, we found that children in the lighter low-birthweight group (<2000 gm) showed smaller magnitude benefits – although the benefits were still significant – than did those from the heavier low-birthweight group (2001-2500 gm).<sup>35,37</sup> Demographically, those in the heavier low-birthweight group had an over-representation of families with very low income and low levels of maternal education, similar to the multi-risk children born into poverty in the earlier North Carolina studies. For these heavier low-birthweight children, at age 3 they showed a mean benefit of scoring 13.2 IQ points higher when they received the Early Education treatment, while those

in the lighter low-birthweight group had an additional 6.6 points. We think this finding suggests there may be a greater need for specialized treatment and supports for the most biologically vulnerable premature infants, and that there also may have been other influential neurobiological factors (not directly measured) associated with their suboptimal prenatal growth and development.

Looking at maternal education as a potential factor in differential effects, Figure 4 displays the IHDP finding that the magnitude of benefits is greater for mothers whose highest educational attainment was less than a 4-year college degree. When looking at the age 3 IQ scores for children in the Health/Social Services group, the well-established stepwise association between maternal education and child test scores appears. This pattern is dramatically disrupted, however, for those in the Early Education group. The early educational program essentially “leveled the playing field” for these low birth weight, premature children and enabled them to perform at levels slightly higher (mean IQs of 104 –107) than the national average at 3 years of age.<sup>12</sup> The greatest benefit was for children of mothers with less than a high school education. These children came from low-resource families that were similar to those in the Abecedarian Project and Project CARE. As Figure 4 shows, these children had almost a 20-point IQ advantage compared to those in the comparison group. In other words, the early educational treatment produced outcomes that allowed these biologically at-risk children to overcome the cognitive “disadvantage” associated with low maternal education and low birthweight.

Interestingly, for children whose mothers were college graduates, the early education program neither increased nor decreased their average tested intelligence at age 3 – which was considerably above the national average. We speculate that the highly educated parents of these low birth weight, premature infants were able to provide opportunities for learning (at home and elsewhere) that were comparable in quality, quantity, and content to what the IHDP home visiting and child development centers offered. These results support our conclusion that there are many ways that young children can receive the active “Transactions with Others & Environment” as well as the 7 daily learning essentials shown in Table 1. The Abecedarian Approach is one way, *but not the only* way. Further many families have the skills, time, and resources to support their children’s early development often combining within-family and extra-familial resources in powerfully supportive developmental practices.

**Figure 4.** The Infant Health and Development Program for premature, low birthweight infants (N= 985): Early Childhood Education\* improved IQ scores for those whose mothers had less than a 4-year college degree



\*In IHDP, the Early Childhood Education group received home visiting in the first year of life (continuing until age 3) followed by 2 years of full-day enhanced childcare and early childhood education based on the Abecedarian Approach (Ramey, Sparling, & Ramey)<sup>16</sup>

Finally, the IHDP analyses offer more direct affirmation of the “dosage hypothesis” as a significant influence in children’s individual differences. Within the education treatment group, we have shown that at both 24 and 36 months of age, there is a significant relationship between children’s IQ and the level of participation in the education program. Specifically, we detected this by creating a Participation Index Score for each child and family - a composite of the days attended at the child development center, the number of home visits completed, and parents’ attendance at planned group meetings. The analyses also took into account other variables, such as maternal education, family income, child birth risk, and the child’s previous cognitive score. These results demonstrate that the yearly participation index predicted a child’s cognitive gains at each assessed age, strongly supporting a cumulative toll hypothesis (i.e., for children who had lower levels of participation) and its corollary hypothesis - that enriched learning experiences produce immediate benefits for children’s cognitive performance (i.e., for children who had higher levels of participation in the second and third years of life).<sup>36,38</sup>

### The Abecedarian Project: Findings during the School Years and Adulthood

The Abecedarian Project followed the children into their middle age years. The long-term outcomes from the Abecedarian Project are highly informative, and once again, include some that were unexpected. The children in the early educational treatment group continued to display benefits associated with their participation in the early childhood program - lasting throughout their school years and well into adulthood.

During the school years, the children in the educational treatment had:

- Significantly higher achievement scores in both reading and math at 8, 12, and 15 years of age – all of the tested ages<sup>29</sup>;
- Significantly lower rates of grade retention (i.e., failing at least 1 grade): 30% of the Abecedarian Early Education group versus 56% in the Health/Social Services Group; and
- Significantly lower rates of placement in special education: by age 15, 12% in the early education group versus 48% of the Health/Social Services group.

The markedly reduced rates of grade repetition and special education are particularly important outcomes, with both fiscal implications for governments and personal consequences for children and families. The cost of special education programs is approximately 2.5 times the cost of regular education. Children in special education are entitled to free public education until age 22 (approximately 4 additional years compared to students in regular education). The U.S. average for placement into special education programs is approximately 11 percent of the school-age population. For many children, the psychological and social stigma associated with being labeled a special education student can be considerable, often with subsequent reduction in their post-high school education and employment opportunities.

At ages 21 and then 30, the individuals in the early education treatment group continued to show multiple signs of significantly more favorable outcomes compared to those who did not.<sup>39,40</sup> Examples include higher rates of holding a skilled job, being employed full-time and/ or enrolled in higher education; much lower rates of becoming a teen parent; few reports of depression and illegal substance use. The higher academic and cognitive achievement scores continued in adulthood as well. Other benefits were much lower reliance on welfare or public assistance programs and better self-rating of their overall health. At age 35, Campbell et al (2014)<sup>41</sup> reported biomedical data indicating the early education group had significantly fewer risk factors for cardiovascular and metabolic disease, especially for males. For example, 25% of the males in the comparison group were affected by Metabolic Syndrome, while there were none in the early education treatment group. These findings are intriguing, and raise many questions about the link between early and lifelong education to health – a well-established relationship in population-based correlational studies. Did increased cognitive and academic abilities earlier in their lives and their higher levels of educational attainment contribute to these adults making more informed healthy lifestyle choices? Did the early childhood education perhaps encourage the individuals to be more physically active? Did their higher status jobs or increased incomes allow them to have better health care coverage and thus they may have received more medical advice and preventive medical interventions?

At age 40, we conducted a major follow-up with novel measures and an unprecedented opportunity for the Abecedarian Project participants to share their own perceptions about being in a study since birth. We assessed brain structure and function,

behavior during structured social decision-making games, and reflections on the quality of their adult relationships with their parents, their civic engagement, and an update on their current assets (e.g., financial, employment, home ownership). Here we selectively highlight some of these findings that expand our understanding of the potential relationship of early experiences to their overall life course.

*Concerning brain development*, Farah<sup>7</sup> previously had reported that childhood poverty was associated with differences in adult brain structure detected via magnetic resonance imaging (MRI). These differences had many hypothesized causes, but prior to the Abecedarian Project 40-year Follow-up Study, there had been no experimental test of early childhood education contributions to adult brain structure. The MRI findings<sup>42</sup> focused on the volumes of five specific brain Regions of Interest (ROIs), a primary summary brain measure, and the overall volume of cortex. Four of the specific ROIs were selected because they appeared particularly relevant to the early educational intervention that strongly emphasized language for communication and building strategies for successful learning and problem-solving. The early educational treatment was associated with an increased size of the whole brain, the cortex, and 4 of the 5 ROIs (the left inferior frontal gyrus did not differ between groups). Further, the group treatment effects for males were substantially greater than for females. We concluded that the Abecedarian Project provides “the first evidence that normal variation in early life experience impacts human brain structure. Specifically, we show that the cognitive and linguistic environment of young humans affects macroscopic brain structure. Unlike previous observational research, which cannot address causality, the present data show that early life experience shapes brain structure, through its immediate causal effects and continuing chains of casual consequences.”<sup>42</sup>

*Concerning social decision-making strategies*, we<sup>43</sup> used well-validated interactive economic games that were constructed to probe social norm enforcement and planning. These games reflect a growing consensus that many of life’s decision-making strategies are socially embedded and this skill relies on a combination of cognitive and social-emotional competencies – that is, practical strategies that could benefit (or harm) an individual, including their own financial, educational, social, and health outcomes. The games involve the study participant making “investments” in back-and-forth activities, in which each of their choices is followed by a move or reaction by their hypothetical partner.

These games involve dynamics associated with being fair to one's partner, while also seeking to win or at least not allow someone else to take advantage of them. These games are enacted so that the study participants can actually earn money if they play the games well (but they never are faced with truly losing money). This is achieved by having sufficient variation in how the hypothetical partners treat the study participants, so that assessment of the sequential behavior of the player reflects how to initiate, cope with, and seek to counteract the different types of behaviors on the part of their partners. What we discovered was:

- Adults who received the Abecedarian Early Education treatment, compared to those who did not, were significantly more likely to enforce equality between the partners during exchanges and to reject overly advantageous offers (that is, when the partners made a decision that was disadvantageous or harmful to themselves). These findings suggest that the Abecedarian early education promoted a stronger belief in reciprocity than simply winning or reaping short-term benefits; and
- Participating in the Abecedarian Early Education treatment was associated, in another multi-round "trust" game, with paying significantly more attention to future and long-term outcomes, compared to the decision-making of those who received the Health/Social Services treatment. This longer "planning horizon" often is considered a signature feature among individuals from more resourceful (higher education, higher income) backgrounds than those from poverty backgrounds – based on research with other study samples.<sup>19</sup>

Here is how we summarized this set of complex findings: "By investing in the early education of highly vulnerable children – with a program that underscores positive adult-child interactions, explicitly teaches about cause-and-effect, permits active learning and early decision-making opportunities, and promotes increasingly complex social cooperation – children realize a brighter future, becoming healthier, more productive, and as our results show, stronger promoters of the norms on which our society is built (p.8).<sup>43</sup>"

*Self-appraisal and self-report about their current life situation* revealed numerous differences between the two treatment groups. For those who received the Abecedarian Early Education, relative to those who did not, they showed higher or improved outcomes that included<sup>43,44</sup>:

- Stronger positive social relationships in adulthood with both their mothers and their

fathers (or parent surrogates) – with highest level ratings of 85.7% versus 58.3%;

- Overall, more favorable ratings of their health – 52.4% at the high levels versus 36.1%;
- Higher percentage with bank accounts, especially having a savings account – 92.9% versus 66.7%; and
- Higher rates of being employed full-time – 78.6% versus 61.1%.

These findings indicate that the middle age indicators of strengths and assets were consistently higher for those in the early education group, although we note that many of those in the Health/Social Services group also provide a positive appraisal of their finances, careers, families, and accumulated assets – much higher than the levels of their parents when they were born in the early 1970s. Other interesting findings were that the geographic dispersion of those in the early education group was significantly greater than for those in the comparison group, and that they were more likely to have their home address be in a zip code associated with higher median incomes, higher employment, higher education, lower crime rates, and lower rates of teen pregnancies and single-parent households.

Finally, through the transcribed dialogues with study participants, we learned that many of those from the early education group showed concern for helping others, either through their chosen careers or volunteer activities or both, and reported active civic engagement, from higher levels of voting to expressing concern about families and children as a societal issue. We also found out that there were some individuals, from both treatment groups, whose lives were facing considerable difficulties and uncertainties. Although there were more severe problems – primarily lack of employment, chronic diseases, and serious family strains – among those who did not receive the early education program, we were impressed that almost all of these individuals reported strategies they were planning to overcome these life challenges, including obtaining more secondary education and/or vocational training and seeking professional help to resolve some of their longstanding personal challenges. Further, the vast majority of the study participants, regardless of their treatment group assignment, expressed gratitude for and positive impressions about having participated in the study throughout their lives, often telling us about the types of help they and/or their parents had received. In the future, we will share a full report on these firsthand accounts and personal insights the study participants shared with us.



In conclusion, from these assessments at age 40, we continued to find multiple outcomes that indicate there have been long-term, real-world practical benefits associated with the different early care and learning opportunities experienced by these individuals. We do not claim, and never have, that all of the group differences can be directly linked solely to receiving a high-quality early childhood education; rather, we think that high amounts of positive learning experiences in a socially responsive daily environment can set the stage for increased benefits when the children enter into a high quality public education system, with cumulative and cascading benefits into multiple domains of life.

### **Estimated Return-on-Investments from the Abecedarian Project and Project CARE**

Cost/Benefit analyses have become an expected feature for public policies concerning child and family programs, particularly for economically poor families. This work applied to early childhood education was pioneered by Barnett<sup>45</sup> using data from the Perry Preschool Project, a study in Ypsilanti, Michigan that provided one or two years of preschool education between ages 3 and 5 to children who had already shown significantly below average IQs by age 3. Barnett and Masse<sup>46</sup> also conducted a preliminary cost/benefit analysis of the Abecedarian program through age 21. They estimated the return on investment was a ratio of 3:1 in terms of dollars saved for every dollar invested. More recently, Garcia et al.<sup>47</sup> have amalgamated data from the Abecedarian Project and Project CARE into middle adulthood at age 35 with a larger dataset and including data about geographically relevant population outcomes. They reported an estimated return on investment of 7.3:1, equivalent to an annualized rate of return of 13.7% for the total costs of providing the 5 years of intensive, high quality early care and education year round. James Heckman, recipient of a Nobel Memorial Prize in Economic Sciences, has been an active and effective spokesperson for the societal economic value of investing in early childhood education, playing a central role in estimating these monetary savings based on results of the Abecedarian Project and Project CARE.

### **Is the Abecedarian Approach Relevant to Today?**

We began the Abecedarian Project and its varied replications in the 1970s and 1980s, when there were many differences from today in the U.S. and world populations, from maternal employment patterns, the child care and public education

workforces, and family structure to the availability of scientific methods to document the neurodevelopmental patterns, biologically and behaviorally, in young children. One of our greatest honors and challenges has been reflecting on the relevance and practical utility of what these longitudinal RCTs have revealed. We have worked closely with scores of local communities, states, and now more than a dozen foreign countries in developing and launching “real world” treatments that build on our findings, as well as those of other developmental scientists. We also have led Congressionally-mandated evaluation studies of major multi-year investments evaluating different models of providing early childhood and elementary school age interventions. Our thoughts about this issue of current relevancy emanate from a long history; at times we remain optimistic about the future of children, while we sometimes are disappointed about the limited success of many well-intentioned and well-funded efforts.

### **Conclusions**

In this paper, we have shared our broad conceptual framework that was designed for use worldwide. The framework has served as a planning guide for others to think about how they can maximize children’s positive “Transactions with Others & the Environment.” We summarize with our appraisal of the scientific findings from studies that tested the Abecedarian Approach.

First and foremost, we think the findings of both immediate and enduring benefits from the Abecedarian Project and Project CARE are instructive for today’s situations. Our colleague, Joe Sparling, has been a leader in translating the Abecedarian Approach curriculum of activities into 7 different languages, often making cultural and cohort adaptations to local contexts and needs. He has worked with his daughter, Kim Meunier, and us, as well as new colleagues and community leaders in Canada, Romania, Australia, China, Denmark, and South America, often focused on enhancing the well-being of children whose families have historically faced oppression and lacked adequate, stable economic and educational supports. This work has been implemented using ethical and community-endorsed RCT designs or by inclusion of relevant comparison groups. The findings to date are encouraging that the overall framework and the Abecedarian Approach transcend a single time or place. For a non-technical overview of published findings about this global research, see “*The Abecedarian Approach to Healthy Development*”<sup>17</sup>).

Additionally, we have sought to identify key features of multiple interventions that produced measurable gains for children and families, in



response to an invitation from the Human Capital Research Collaborative. We presented our conclusions at a conference hosted by the Federal Reserve Bank of Minneapolis on the critically important topic of “increasing and sustaining early childhood development gains.” We nominate this set of hallmarks for those considering how best to develop and implement successful early childhood and family programs. Table 3 lists these hallmarks.

Strategizing to improve the future for children is a monumental and highly complex endeavor. The findings we have summarized here are shared in the

spirit of contributing potentially useful information for others. We strongly endorse the position that a systematic and comprehensive approach that begins early in development is among the most promising strategies to improve important lifelong outcomes for children and families from all walks of life. We think that creative, committed, and even sometimes competing groups can cooperate in leading efforts that contribute to more vibrant, healthy communities that sustain and improve the lifelong well-being of all citizens.

**Table 3.** Hallmarks of Early Childhood Education Programs that Produced Large Benefits (adapted from Ramey & Ramey, 2019)<sup>48</sup>

1. Leadership at the highest level was stable, highly engaged, and deeply knowledgeable about the content of the program. Program leaders had a strong professional stake in the conduct of the project.
2. The content of the programs was based on existing scientific findings and scientific theory about children’s development, rather than ideology or philosophy alone.
3. The programs were relatively intensive -- often engaging program children and/or family members over a fairly long period of time. Although program dosage is extremely difficult to equate across different types of programs for different types of children and families, in general higher intensity programs tend to yield higher benefits.
4. Multiple features and components were specified in the program to achieve maximum desired experiences for children, along with flexibility for intended individualization of the standardized protocol. That is, children’s intertwined development and needs were recognized; this usually necessitated engagement of experts from diverse disciplines and specialty areas.
5. Before the program was implemented, it was supported by both external peer review (content experts) and by respected members or opinion leaders in the local community (local endorsement).
6. Program staff received strong training and professional development related to the intervention, and this included provision of active, ongoing supports and systematic supervision with feedback.
7. Implementation of the program was actively monitored by leaders, which helped to detect and resolve problems early as well as to reward staff. Performance expectations were clear to staff, as well as the immediate goals for improving children’s education and health outcomes.
8. High levels of participation among all children and families were strongly supported from the very beginning and at all stages, including strategic plans to overcome the most likely potential barriers to full participation (e.g., transportation, illness policies, hours of operation, program schedule).
9. Children’s progress was frequently assessed by objective and unbiased methods, and valued as vital to understanding whether the program was able to achieve its intended benefits on children’s lives. Evaluation was not viewed as something that was “externally imposed,” or something that was intrusive or competed with program resources for children.
10. The information gathered about the program and about children’s progress was analyzed and reported to both the program leadership team and to external groups, as appropriate, including presentation at leading professional organizations.
11. Program developers recognized that replication of the program would be an important next step if the results affirmed benefits to children and families. Thus, the program’s content and procedures were documented sufficiently to allow replication.
12. The leadership had sufficient levels of resources and direct control over expenditures so that the key components of the planned program would be delivered, while knowing that they could rapidly make adjustments if and when problems occurred. The scale of these programs was small to moderate, and there was a good perceived match between resources available and the expectations for implementation.

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