

CHAPTER 21

Children's Health and Education

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Children's health and education can be facilitated by systematic supports that span traditional and innovative health care, health promotion, and disease prevention and that apply scientific principles about how young children learn and develop. Conversely, children's development can be impaired by disease and injury, nonoptimal lifestyle, the presence of multiple risk factors, and the failure to receive high-quality experiences to promote cognitive, social-emotional, and physical well-being.

During the past half-century, a new field has emerged—prevention developmental science (e.g., Bryant, Windle, & West, 1997; Coie et al., 1993)—that systematically integrates theories and methods from the broad fields of public health, psychology, medicine, sociology, and education to improve developmental outcomes for

children at risk for a wide variety of poor outcomes in health and education. Exciting integrative advances in developmental neuroscience have conjoined with prevention science to fuel design and implementation of studies about the fundamental interconnectedness of children's health and education (e.g., C. T. Ramey & Ramey, 2004a; Teti, 2004). Indeed, many of the health disparities and inequities in children's educational attainment are likely the result of this complex interplay between health and education (e.g., Livingston, 2004).

David Satcher, 16th surgeon general of the United States and now director of the National Center for Primary Health Care at Morehouse School of Medicine, has used what is termed a health disparities lens to bring into focus the huge toll taken on the well-being of many individuals from historically marginalized and minority

groups, especially children of color and children with disabilities. Satcher (2004, p. xxxi) summarized:

Although major progress has been made in reducing morbidity and mortality, as well as increasing the life expectancy among vulnerable and at-risk populations, such as African Americans, the ethnic divide continues to widen. As a matter of fact, in some cases it has even gotten worse! Because we are essentially dealing with the inherent complexities of human behavior on the micro or individual level, which are inextricably tied to ongoing factors and conditions at the macro or societal level, the reasons for the lack of more substantial improvements over the ensuing years are complex. . . . To suffice, however, it can be reasoned that increased vulnerability to adverse health among [targeted subgroups] is differentially mediated by various environmental factors and conditions. All of these factors and conditions serve to influence individuals' personal choices concerning health lifestyle choices; availability, accessibility, and acceptability of services; and, ultimately, impact negatively on their physiologic functioning, hence the current health disparities dilemma. At the risk of oversimplifying a complex situation, what is desperately needed at the macro level is health-care reform to guide the nation's policies and research agenda.

We concur that such health care reform is imperative, and argue further that the need for educational reform is equally compelling. Satcher's (2004) observations about vulnerability apply soundly to educational inequities as well as to health.

For more than 3 decades, we and many other developmental scientists have constructed broad conceptual frameworks that build on biological systems theory (e.g., Bertalanffy, 1975; Miller, 1978) and social ecology and Gestalt theory (e.g., Binder, 1972; Bronfenbrenner, 1977, 1979; Lewin, 1936, 1951; Stokols, 1992, 1996) and extended it to delineate social transactions (cf. Lewis, 1984; C. T. Ramey & Ramey, 1998a; Sameroff, 1983) that shape the course of individual development. These conceptual frameworks incorporate fundamental assumptions about the interconnectedness of the individual and the environment, biology and behavior, and the dynamic nature of changes over time. Similarly, developmental science has acknowledged that "dividing the child" into separate functional strands of development—such as perceptual, motor, cognitive, social, emotional, and physical growth—is largely arbitrary, based on historical disciplinary fields in which different aspects of human functioning were studied and treated. Today, the evidence compellingly supports the

strong interdependencies among multiple domains (outcomes) of development; that is, a child's development is more aptly depicted as intertwined, overlapping, and codetermined by influences within and outside the child.

The historical disciplinary isolation in both academia and clinical and educational practices that serve children (e.g., education, pediatrics, psychiatry, social work, psychology, rehabilitation, nutrition, physical education) contributes to the lack of a common language and an acknowledged awkwardness in finding words to capture this more integrated transdisciplinary and biosocial perspective. Many developmental and biological scientists have demonstrated the inadequacy of simplistic nature-versus-nurture formulations of development (e.g., Borkowski, Ramey, & Bristol-Powers, 2002; Moser, Ramey, & Leonard, 1990; Shonkoff & Phillips, 2000); comparably, others have highlighted the flaws of trying to measure independent contributions of the environment to the individual, and vice versa (e.g., Landesman-Dwyer & Butterfield, 1983; Lewis, 1984; S. L. Ramey, 2002). We, too, struggle to overcome the dominance of the older ways of thinking. This is reflected in the fact that we still emphasize that health includes mental health, that cognition also refers to social and emotional cognition, and that social competence is more than behavioral interactions but includes mental representations and problem solving in the social realm. Indisputably, brain and behavior are interdependent, perhaps fundamentally inseparable; but current measurement strategies and analytic frameworks constrain how we formulate the role of children's experiences in their biological and psychosocial behavioral development, and how health impinges on education and vice versa.

In this chapter, we describe the broad conceptual framework with which we have been working, known as applied biosocial contextual development (ABCD), that considers health and education as key outcomes influenced by individual, family, and environmental contexts and processes, incorporating biological and behavioral factors. We then present an example of a multidisciplinary, longitudinal, large-scale, randomized trial that embraced this conceptual framework to inform study conceptualization, design, measurement, and analytic strategy. We selectively highlight both health and educational outcomes from these studies. Next, we identify five principles of effective early childhood interventions, supported by results from a wide array of randomized controlled trials (RCTs) of early childhood health and education interventions. We conclude that there is

great potential to apply theoretical, technological, and practical advances in innovative ways to improve children's well-being, to reduce health disparities, and to ensure educational adequacy for all children (S. L. Ramey & Ramey, 2000). We outline key features of community collaborative and participatory research and recommend that universities, scientific organizations, advocacy groups, philanthropy, government agencies, and professional practices seek new alliances that transcend the historical and political boundaries that contributed to unduly complex, inefficient, and often ineffective systems for the delivery of health and education supports and for vigorous scientific inquiry.

THE CONNECTION BETWEEN HEALTH AND EDUCATION

Higher levels of educational attainment have long been associated with better health status among adults, and poor health among children is widely recognized as an impediment to full participation in formal education (cf. Waldfogel & Danziger, 2001). That both educational attainment and health status are closely linked to socioeconomic status, residential conditions, and the presence of major disabilities also is irrefutable. What has not been explored carefully—particularly via prospective, longitudinal scientific inquiry with ethnically and economically diverse populations—are the ways health and education mutually and dynamically influence the course of a child's life, and how educational and health factors in turn influence subsequent generations.

DEFINING BASIC TERMS: HEALTH, EDUCATION, AND DEVELOPMENT

To help promote a common language for the field of young children's health and education, we provide explicit definitions of basic terms. We endorse the World Health Organization's (World Health Organization, 2005) definition of "health" as "*the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.*" The WHO definition was once considered revolutionary, with its emphasis on health as multifaceted, its endorsement of the centrality of mental and social well-being, and its position that

health was fundamentally synonymous with complete, optimal human functioning.

We regret that the term "education" is frequently used in a quite narrow way to refer only to the formal system of external supports to instruct children academically, often reducing education to a variable measured as "years of education," or "most advanced degree earned." Alternatively, we advocate a broader definition of education intended to reflect an individual's actual attainment and application of knowledge and skills. The Random House Dictionary of the English Language, second edition, Webster's unabridged (1987, p. 621), defines education as "the active process of imparting or acquiring general knowledge, developing the powers of reasoning and judgment, and generally of preparing oneself or others intellectually for mature life." Education, thus defined, encompasses many life experiences outside of formal schooling and didactic instruction. Undeniably, one of the major childhood tasks is to do well in school and to participate in the formal system of education; yet increasingly, social and life skills are recognized by educators and parents as vital to a child's learning. In this chapter, we use the term education to represent *the child's own acquisition of intellectual competencies, including practical, creative, and logical-deductive thinking.* As such, education is a measurable, multifaceted child outcome, just as health is.

We use the term "development" to capture *an ongoing set of biological, psychological, and social processes that result in measurable change(s) at the individual level that reflect increasing differentiation and hierarchical integration of functions.* Development is often described in everyday terms such as increased competencies, greater maturity, and more refined and adaptable skills, which in turn help a child prepare for a large number of diverse and often unexpected encounters and life challenges. Development progresses in ways that alter both internal functioning and external behavior. Internal functioning includes sensory and motor perceptions, feelings, thinking, remembering, and metacognitive strategies that help a child to govern his or her plans, reasoning, and actions; external behavior spans basic actions to complex performance in everyday situations and in formal evaluations or tests of skill, knowledge, and problem solving. Development can include incremental, steady changes as well as major transformations and the emergence of new classes of behaviors at different times and stages of life. Ultimately, devel-

opment is purposive, such that development contributes to the individual's increased adaptability and effectiveness of thoughts and behavior, including social transactions, which in turn promote the individual's ability to understand the world and successfully contribute in an ethically principled and constructive manner to his or her society and its future.

Collectively, these terms characterize important universal goals for children: that children *develop* in ways that promote their *health* and their *education* and that children's *health* and *education* directly contribute to and are part of their *development*.

APPLIED BIOSOCIAL CONTEXTUAL DEVELOPMENT: A CONCEPTUAL FRAMEWORK FOR UNDERSTANDING, DESIGNING, AND TESTING INTERVENTIONS TO IMPROVE CHILDREN'S HEALTH AND EDUCATION

Figure 21.1 presents the conceptual framework with which we work, named applied biosocial contextual development (C. T. Ramey, MacPhee, & Yeates, 1982; C. T. Ramey & Ramey, 1998a; S. L. Ramey & Ramey, 1992). ABCD incorporates both health and education as explicit outcomes, through pathways that represent multiple levels and sources of influence on a child's development. ABCD is well-suited for designing, implementing, and evaluating early interventions and preventive programs to improve children's health and education outcomes, because ABCD addresses the whole child in the child's natural multiple settings and environments.

In the left column of Figure 21.1, the box labeled Child is centered within the Family, because young children are dependent on the care of others (note: As a convention, we capitalize words that denote major components in the figure). The term Family means those caring for the child, regardless of whether they reside together, and recognizing that roles and legal relationships may fluctuate over time. Family identifies those people who assume the ethical, practical, and legal responsibility for a child. Next, the child and family are surrounded by eight boxes indicating major domains of functioning and influence. The status of the child and family in each domain is hypothesized to be interre-

lated. A holistic picture of a child and family is a central feature of ABCD, such that study of one aspect of development, such as a child's health status or a child's reading achievement, is likely to be advanced through more comprehensive study of what is happening in multiple domains of the child's and the family's life. Though this is cumbersome for research and for those who implement interventions to improve child outcomes, the failure to recognize this reality often becomes a serious obstacle to realizing desired comprehensive outcomes. The eight domains are Survival Resources to meet the child's and family's basic needs; Health and Nutrition; Safety and Security; Appraisal of Self; Motivation and Values related to child and family functioning; Social Support; Communication Skills; and Basic Academic, Social, and Work Skills.

Figure 21.1 shows multiple influences on the eight functional domains, deriving from (a) the Community Context, with its specific Community Resources; and (b) Biology and Prior Experiences. The Community Context can be measured from the closely proximal to more distal relationships in the young child's life, and includes Community Resources, such as Social and Child Care Supports, Supports for Learning, Physical Supports, Health Services, and School Systems. For young children, these community resources often directly influence their health and education status, with resources impinging on family supports for the child (e.g., job training and literacy, parenting programs, substance abuse and mental health treatments for family members) and sometimes directly affecting the child (e.g., exposure to toxic substances, risk while in child care, supports from school readiness programs). Of equal theoretical importance are influences subsumed in the lower box labeled Biology and Prior Experiences. These include Intergenerational Influences, Individual Biology, and the cumulative experiences of a child and the child's family members. We admit that trying to display a dynamic, ever-changing systems theory in a two-dimensional, static, black-and-white format that fits onto one page is a nearly insurmountable challenge, and we judge our pictorial representation to be limited in adequately reflecting the complex pathways and feedback loops that are so eloquently identified by David Satcher (2004; see earlier quote). A video representation illustrating how distinctive, time-distributed inputs and processes would be a more suitable format for capturing the ABCD framework. For now, the words and

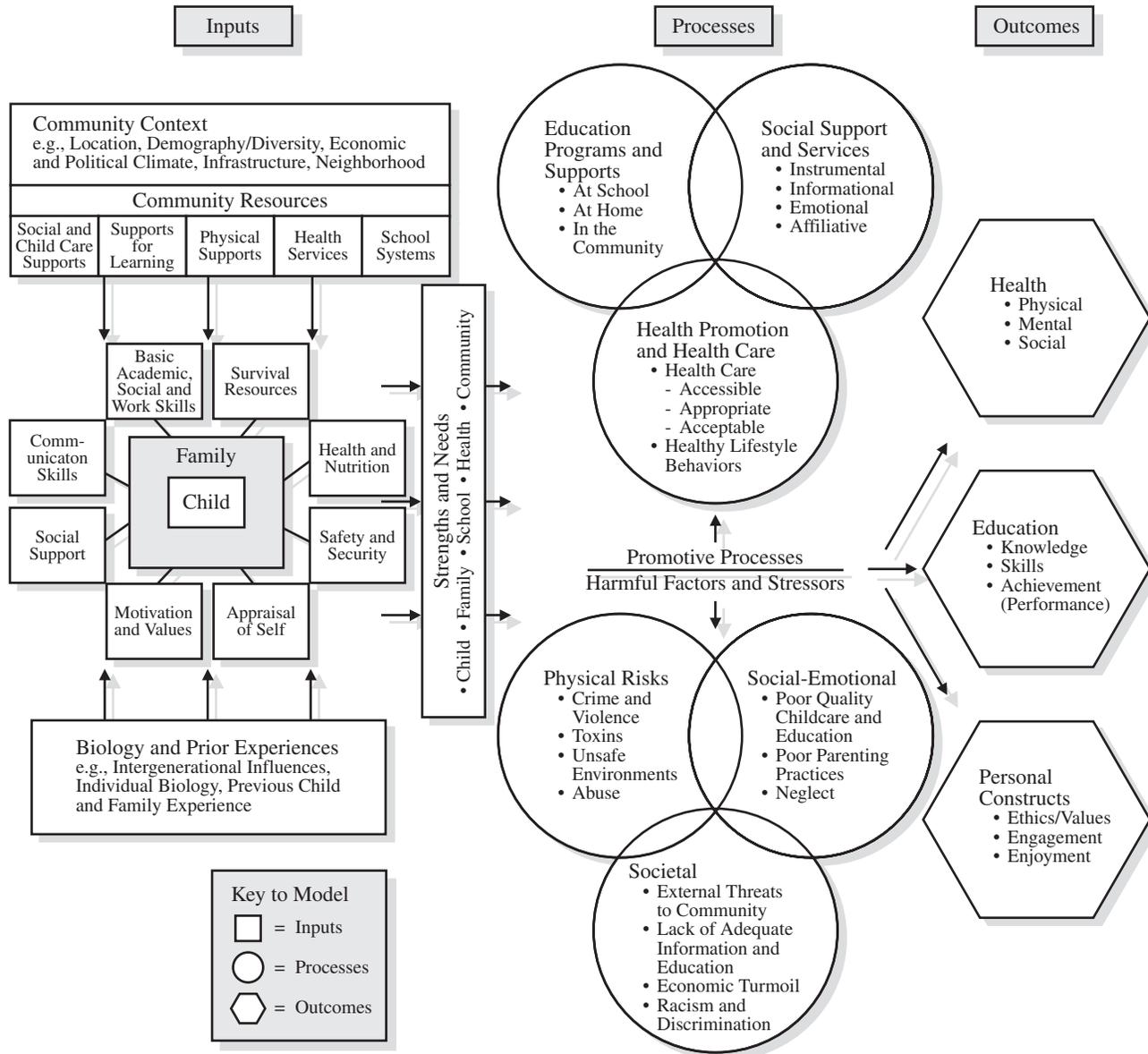


Figure 21.1 Applied biosocial contextual development (ABCD): a conceptual framework for health and education interventions.

the reader's own comprehension of the extensive developmental science findings of the past century will have to suffice.

As a systems theory, a fundamental premise of ABCD is that changes in the child and the family serve to alter both biology and experiences, as well as to possibly alter community context and community resources, particularly when children and families change in ways that affect the availability, the appropriateness, and/or the acceptability of prior community resources.

Together, the child's functioning in all of the major domains serves to undergird what are defined as outcomes, that is, the formal assessment at a specified time or a sequential portrayal of a child's status at multiple time points (i.e., developmental trajectory). We acknowledge that there is considerable ambiguity and circularity in separating an outcome from a child's functioning. In fact, we think these are one and the same, in many cases, because the very processes inextricably linked to a child's development are what become

part of the measurement of an identified outcome. For example, a child's experiences in the realm of language and how a child functions in terms of everyday communication and academic aspects of language and literacy are actually simultaneously developmental processes and developmental outcomes. In the realm of health, for instance, how a child's body handles the metabolism of carbohydrates is part of what defines an outcome related to hyperglycemia (e.g., risk for or presence of diabetes). Typically, the term "outcome" is one of convenience for clinical, administrative, and research purposes, as a check on the child's status at a moment in time. Sometimes, an outcome is represented in terms of a more global and personally meaningful or valued outcome, such as "doing well in school," which is a composite or multifaceted outcome with many indicators rather than a single measure. Rarely are outcomes amenable to measurement in absolute terms, even when the outcome is a biomedical marker. For example, over the past several decades, the clinical definitions used to diagnose diabetes, childhood obesity, and childhood autism have changed considerably (they are relative definitions, not absolutes). Similarly, intellectual and education outcomes rely primarily on nationally normed standardized tests, which means that approximately half of all children will always be classified as "below national average," even if all children realized considerable gains in absolute levels of academic achievement. Accordingly, when selecting outcomes, scientists and practitioners benefit from seeking a consensus about what are positive, valued, and adaptive health and education outcomes for young children. Outcomes can never be value-free, although the measurements can become increasingly well specified, standardized, and scored in ways that allow valid comparisons of changes over time, cohorts, and contexts.

This values and relativistic perspective is part of the reason the name of our conceptual model includes the term "contextual." Applied biosocial contextual development is basically an inductive framework to promote incorporating new findings and greater specificity and directionality to its components, and eventually to inform interventions that are designed to be maximally effective and efficient in yielding desired (valued) child health and education outcomes.

In the realm of outcomes (depicted as octagons on the far right of Figure 21.1), we display the well-recognized areas of Health and Education, as well as a third out-

come to encompass dimensions of a child's life that do not easily fit within health and education. We hearken back to the pioneering work of George Kelly (1955), who advanced the concept of "personal constructs." Kelly's innovative contribution was to bring a phenomenological (personal, experiential) perspective to bear on the major issues in psychology. How an individual understands his or her world, and the personal value assigned to experiences, is an undeniable filter, one that perhaps has been overlooked for too long in the field of developmental science. Similarly, Vygotsky (1978) advanced the theory that consciousness was an end product of socialization, and explicitly identified a cognitive-cultural component that served a central role in creating the child's individual reality. Rarely are these dimensions included in the study of young children's health and education. By explicitly including this personal constructs dimension, ABCD advances the idea that children may respond differently (i.e., in an idiographic way) to the same environments—even environments considered "good" or "bad" for most children—and that the reasons for differential responding transcend variables such as age, gender, ethnicity, skill level, and presence/absence of major health conditions. Also, we provide examples of meaningful dimensions of life such as Ethics/Values, Engagement, Enjoyment, and Perceived Social Support because they capture highly valued aspects of life that are not included in conventional outcome measures of health and education.

The processes hypothesized to influence outcomes (depicted in circles in the center of Figure 21.1) are represented in terms of two major types: Promotive Processes and Harmful Factors and Stressors. Depending on the focus of a study and an intervention, greater or lesser specificity about the particular types of processes is needed. Children's outcomes, in general, are hypothesized to be supported by Educational Programs and Supports at School, Home, and in the Community; by Social Support and Services that provide Instrumental, Informational, Emotional, and affiliative support (e.g., Reid, Ramey, & Burchinal, 1990); and by health promotion and health care, including healthy lifestyle behaviors. Even when children receive promotive supports, their development can be threatened by Harmful Factors and Stressors. These represent actual risks the child experiences directly, not merely the community or family context that may increase or decrease the probability that risks will occur. Harm can occur in

many domains, including the child's physical, social and emotional, and personal constructs development. In general, harmful factors and stressors have exerted a strong effect on children's outcomes, although there has been high interest in children who appear resilient, invulnerable, or successful in overcoming these risk factors (e.g., Garmezy, 1983; Grotberg, 2003; Rutter, 2000; Werner, Bierman, & French, 1971).

OVERVIEW OF APPLICATION OF THE MODEL TO EARLY INTERVENTION RESEARCH

The ABCD conceptual framework has been used for several multidisciplinary RCTs of prevention and intervention programs in early childhood. These include the Abecedarian Project and Project CARE (e.g., Campbell, Pungello, Burchinal, & Ramey, 2001; Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; C. T. Ramey, Bryant, Campbell, Sparling, & Wasik, 1988; C. T. Ramey & Ramey, 1998b; Wasik, Ramey, Bryant, & Sparling, 1990), which sought to prevent intellectual disabilities and to improve school achievement among extremely low resource families; the eight-site RCT called the Infant Health and Development Program (IHDP), which adapted the Abecedarian Project and CARE early intervention program for use in the first 3 years of life with premature, low-birthweight infants (e.g., IHDP, 1990; C. T. Ramey et al., 1992); and the National Head Start-Public School Transition Demonstration Project conducted in 31 sites to test the effectiveness of 4 continuous years of comprehensive health and education supports (cf. S. L. Ramey, Ramey, & Phillips, 1997; S. L. Ramey et al., 2001; the latter study is described in detail later in the chapter). All of these studies were grounded in theory and prior research findings and adopted an explicit and broad integrative, multidisciplinary conceptual framework, derived from ABCD, (a) to inform the design of the intervention or prevention strategy; (b) to select the measurement approach to document inputs, processes, and outcomes; (c) to guide the data analyses that considered multiple and intersecting influences on the major health and education outcomes; and (d) to refine and further specify the nature and magnitude of influences on child developmental trajectories in specified developmental domains.

In writing this chapter, we would like to acknowledge that it has not been "standard science" to endeavor to conduct a rigorous study of both health and education for young children within a single longitudinal study. Although almost all longitudinal research in developmental psychology includes some marker-level variables in health and education, research historically has been more focused, studying, for example, children's mental illnesses (usually a particular form of mental illness), children's cognitive and academic development, children's social skills and behavioral problems, or children's medical illnesses or injuries. These studies have led to a rich scientific literature in these discrete but remarkably unlinked fields. The scientific journals have multiplied and become, in most cases, narrower and more topic-specific, with only a few integrative and transdisciplinary in their focus. This reflects, in large part, the traditional organization of universities into departments and schools, as well as the scientific review process that favors proposals that are more narrowly focused. For an argument in favor of major university reform to support multidisciplinary and transdisciplinary scientific inquiry and practice related to children's health and education, see S. L. Ramey and Ramey (1997b) and C. T. Ramey and Ramey (1997b).

There is strong evidence that the National Institutes of Health (NIH) has embraced the need for new, innovative, and integrative approaches—with corresponding implications for university organization and operations—in the evolving NIH road map (described on the NIH Web site), as well as the reorganized National Science Foundation, the National Academy of Sciences in the U.S. Department of Education (e.g., see the outstanding summary of early childhood research by Shonkoff & Phillips, 2000), and the Institute of Education Sciences, newly created by the U.S. Congress.

We judge the greatest challenges that derive from ABCD to be the discovery of ways to support the preparation of scientists, practitioners, and policy shapers to work collaboratively and to understand this integrative worldview of how children develop. An urgent priority is to align intervention, prevention, and promotion activities in productive and open ways with research, practice, evaluation, and policies to achieve maximal benefit for children, their families, their communities, and society at large (S. L. Ramey & Ramey, 2000). An exceptionally promising line of scientific inquiry directly addresses the dynamic relationship of a child's

education to his or her health and the ways healthier children may be more likely to benefit from opportunities to advance their education. In turn, intergenerational effects of increased health and increased education may convey particular benefits to the next generation, mediated through interdependent biological and social mechanisms.

THE NATIONAL HEAD START-PUBLIC SCHOOL EARLY CHILDHOOD TRANSITION DEMONSTRATION PROJECT: A 31-SITE RANDOMIZED TRIAL TO PROVIDE COMPREHENSIVE HEAD START-LIKE SUPPORTS TO CHILDREN AND FAMILIES FROM KINDERGARTEN THROUGH THIRD GRADE

In this section, we provide an overview of a longitudinal and experimental study that adopted a prevention science approach to the design and measurement of systematic, multipronged health and education interventions to decrease risk and to increase both the educational competence and the health and well-being of young vulnerable children. We selected this study because it represents a well-supported, multiyear effort to transform the field of early childhood inquiry by engaging individuals from multiple disciplines; working closely with practitioners, scientists, and policymakers from the start and throughout the project; establishing internal and external oversight mechanisms to promote scientific rigor and integrity; and creating public use data sets that are amenable to productive secondary data analyses to advance the field. Within the confines and intent of this chapter, we do not strive to provide a compendium of all the findings from this research project. Rather, we selectively describe the project's purposes, delineate the key components of the intervention program and its corresponding data collection strategies, and report some of the findings to date that have implications for practice, policy, and future large-scale studies of health and education.

Study Purpose and History

In 1991, the U.S. Congress passed legislation titled the Head Start Transition Project Act, authorizing funding to test the value of extending comprehensive and contin-

uous Head Start-like service and supports to children for the first 4 years of elementary school. Local sites competed for funding to do the following: (a) develop promising strategies in which Head Start programs, parents, local education agencies (LEA), and other community agencies joined together to plan and implement a coordinated, continuous program of comprehensive services for low-income children and their families beginning in Head Start and continuing through third grade; (b) to develop ways to support the active involvement of parents in their education of their children; and (c) to conduct rigorous research at the local and national levels, using a randomized design to assign children and schools to the transition demonstration condition or the comparison group. The 31 funded sites were dispersed across 30 states and one Indian nation. More than 8,700 former Head Start children were enrolled and nearly 3,000 additional classmates. A distinctive feature of this intervention was that it was provided for the entire classroom, rather than just singling out former Head Start children.

Application of the Conceptual Framework to the Design and Evaluation of the Intervention

Figure 21.2 shows how ABCD was used to help frame the conceptualization of the interventions and to represent, in a general way, how the health and education components of the intervention were hypothesized to improve child health and education outcomes. As shown on the lower left side of the figure, the Planning Stage (a 1-year period) for the Transition Demonstration Program involved local adaptation of a national Program Model that mandated certain components to achieve the "comprehensive Head Start-like" feature of the program. The model established a Governing Board (with at least 51% of membership from parents of children to be served); local decision making regarding Program Implementation (the logistics of who would be hired, how local partnerships would be formed and operate, and specific plans to change Community Resources designed to improve outcomes); and Program Costs (an essential area for ensuring that intervention programs can be adequately implemented and replicated across sites).

The Planning Stage also involved creating and nurturing a National Consortium of the 31 sites, with each site having a three-way partnership of Head Start, the public schools, and an evaluation team typically at a university or research firm. At the national level, the consortium

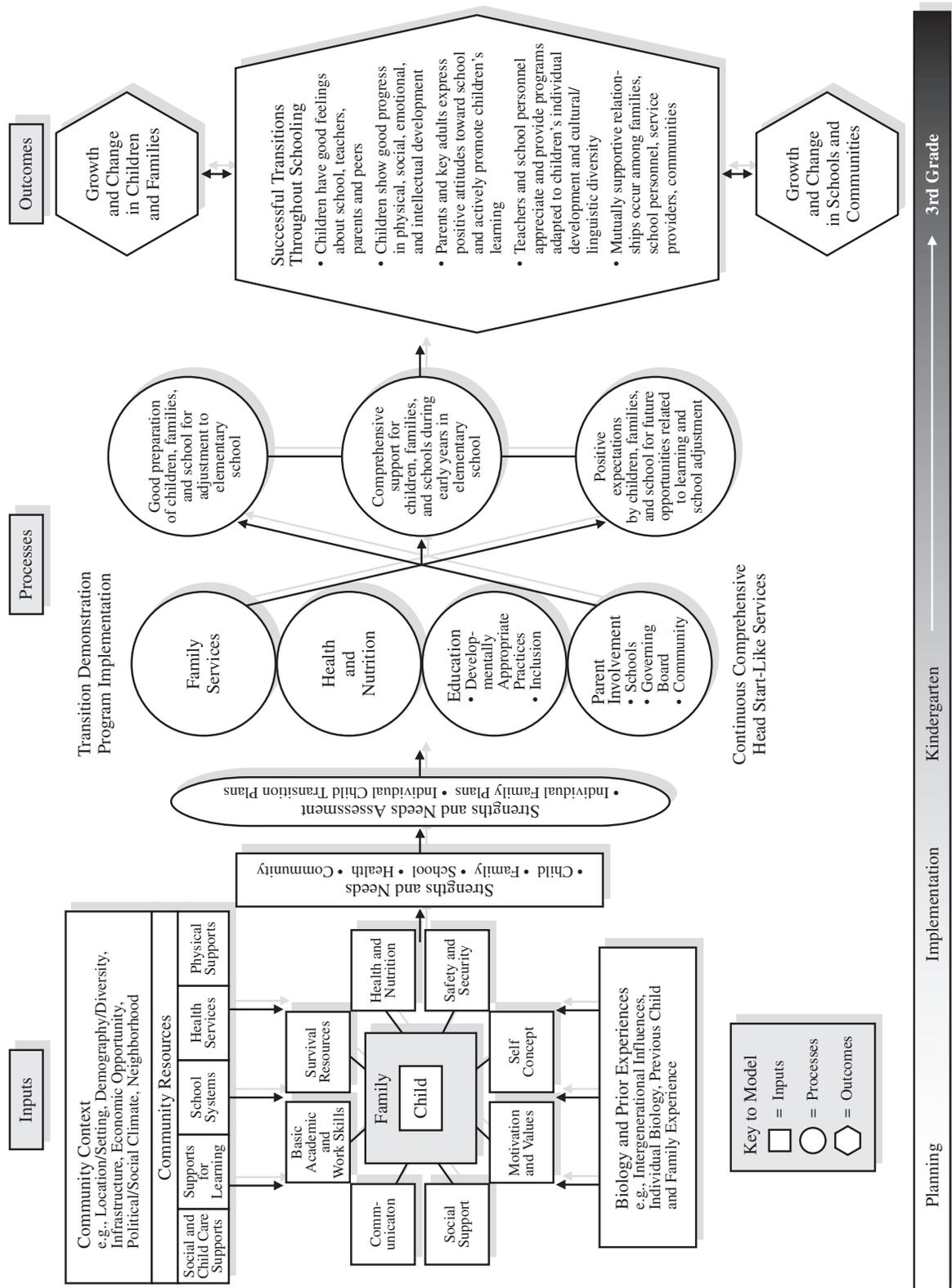


Figure 21.2 The conceptual framework used for the National Transition Demonstration Program. *Source:* From “Evaluating Educational Programs: Strategies to Understand and Enhance Educational Effectiveness” (pp. 274–292), by S. L. Ramey and C. T. Ramey, in *Continuing Issues in Early Childhood Education*, 2nd ed., C. Seefeldt and A. Galper (Eds.), 1997b, Englewood Cliffs, NJ: Prentice-Hall. Reprinted with permission.

addressed the eight functional domains (represented by eight boxes surrounding the child and family), endorsing their importance for the intervention and the research, and further specifying how these domains would be assessed at the beginning of the study (baseline) and throughout the course of the study (4 years).

As Figure 21.2 displays in the Implementation Phase (identified along the x-axis at the bottom of the figure), each site was to conduct an individualized Strengths and Needs Assessment for all participating children and families. This assessment was referred to as an Individualized Transition Plan that addressed the strengths and needs of the child and the family. This assessment was designed to maximize early identification of any special supports and services for a successful transition to school. As shown to the right of the oval on assessment, the major components of the Transition Demonstration Program are identified in four major areas: Family Services, Health and Nutrition, Education, and Parent Involvement. Collectively, these four areas constitute the comprehensive Head Start-like services. The time period for implementation was from the planning for kindergarten entry (ideally, in the year children were served by traditional Head Start) through each of the next 4 years in public school, with systematic efforts to ensure continuity of planning and supports from grade to grade.

For evaluation, the ABCD conceptualization was used to identify what would be measured, starting with descriptions of each local site in terms of the Community Context and Community Supports; comprehensive assessment of the child and family's health and education, including multiple measures designed to tap the constructs in each of the eight functional domains; and ongoing and annual documentation of program implementation, combining program participation data from the local site with external multidisciplinary site visits during which additional data were collected and the local site program documentation was verified. In Figure 21.2, the Transition Demonstration Program services are shown to contribute to three general areas (processes). That is, the intervention program was hypothesized to change children's health and education outcomes through three primary pathways. The first was creating "good preparation of children, families, and schools for the child's adjustment to elementary school." The Individualized Transition Plan and the process of creating local partnerships around the topic of positive school transitions were central features altering the

community- and family-specific context for school readiness. The second pathway was "comprehensive support for children, families, and schools during the early years in elementary school." This was hypothesized to result from the many in-school supports and community-based activities for children and parents, increased professional development activities for educators, and multiple parent involvement programs to facilitate children's academic progress. Third, "positive expectations by children, families, and schools for future opportunities related to learning and school adjustment" was included as a specific pathway. Measures of this were obtained by in-depth open-ended and structured interviews with families, teachers, principals, and children themselves.

This project recognized that in many communities, the poor performance of children in the past set the stage for low expectations and concomitant dismal predictions of outcomes for children from low-income families. An explicit component of the intervention was to change these expectations for academic and life success, that is, to create an expectation that the historical health disparities and educational inequities could be significantly reduced or eliminated. Collectively, the processes of increasing preparation for school success, providing supports for health and education during the early elementary school years, and increasing expectations for positive outcomes among a large stakeholder group surrounding the child are the general pathways—each of which was measured by multiple indicators throughout the study—conceptualized as producing positive outcomes.

Finally, Figure 21.2 indicates the outcomes (the octagons in the far right column) specified for the Transition Demonstration Project. These agreed-upon outcomes, building on an earlier shared vision and local community partnerships and input to the national evaluation, transcend the typical academic indicators of test scores only, and reflect the fact that outcomes for a large, intensive intervention or community reform effort should correspond to ways that the stakeholders actually think about children and their well-being. Specifically, we note that some subjective measures are identified as legitimate outcomes, such as "Children have good feelings about school, teachers, parents, and peers" (what most people call "liking school" and "positive school attitudes"), as well as their parents and teachers having positive attitudes and being actively engaged in their children's learning. Although outcomes such as

having “mutually supportive relationships among families, school personnel, service providers, and communities” can be challenging for researchers to measure, these are important valid outcomes to target. Of course, children’s health and educational status are also measured, but these did not constitute the sole indicators of effectiveness for this National Transition Demonstration Program.

By using the ABCD conceptual framework, the progress of the project and the extent to which goals were realized could be studied in a prospective way, assessing year-by-year changes at the level of the child, the family, the school, the health and social service delivery system, and the community as a whole. More important, the steps from Planning through Implementation could be tracked, so that if intended outcomes did not occur, the supportive processes could be carefully reviewed to consider likely explanations for differential benefits across and within the 31 sites.

Measurement of Inputs, Processes, and Outcomes

The ABCD framework facilitated the identification of constructs to be measured. Table 21.1 presents an overview of the measures selected and links these to the ABCD model. (For further details and references about methodology, see S. L. Ramey et al., 2001.) Note: this data set is now in the public domain, with supportive data dictionaries and summary variables available.

Selected Findings from the National Transition Demonstration Study about Children’s Health and Education

In this chapter, we chose findings about three topics often overlooked in conventional studies of children’s health and education: children’s perceptions about their school experiences, the developmental trajectory of academically gifted former Head Start children, and the ways families protect children from injuries.

Children’s Feelings about School

Children’s feelings about school, as revealed during a Vygotskian-style dialogue, permitted children as young as 5 years of age to tell the child assessors how they felt about things happening in school. The areas rated by children included how well they got along with their teacher and peers; how important they and their parents (separate queries) thought it was to do well in

school; how much they liked school; how well they thought they were doing in academic areas; and how good their teacher was at teaching them new things. The dialogue “What I Think of School” (Reid et al., 1990) has good psychometric properties and is sensitive to individual differences. For example, S. L. Ramey, Lanzi, Phillips, and Ramey (1998) reported that by the spring of kindergarten, about 7% of former Head Start children were having multiple negative perceptions of school. Especially impressive was the finding that children’s negative early perceptions were highly predictive of subsequent academic progress in reading and math, as measured by standardized assessments and teacher ratings, and that children’s feelings about school contributed significant information above and beyond the measures of their kindergarten-level language, reading, math, and social skills. Children’s impressions of school fit within the outcome labeled Personal Constructs in the ABCD conceptual model (Figure 21.1). We interpreted this finding to support the recommendation that children’s experiences warrant inclusion in almost all investigations of children’s school adjustment and their mental and physical well-being. Also, this finding exemplifies a practically useful result well suited for sharing with educators and program staff. That is, in a collaborative style of program research and evaluation, information such as this can help inform subsequent changes in the intervention—perhaps to encourage the programs, teachers, and parents to consider children’s feelings as important early warning signs that are likely to precede awareness by the adults that things are not going well.

High-Achieving Low-Income Children

Another interesting set of findings from this multisite, multidisciplinary longitudinal study concerns identifying a subgroup of children with exceptionally positive development. Analysis sought to understand the supportive and protective factors in their lives (Robinson, Lanzi, Weinberg, Ramey, & Ramey, 2002; Robinson, Weinberg, Redden, Ramey, & Ramey, 1998). All too often, studies grounded in a commitment to eliminate the health and educational disparities concentrate disproportionately on the negative outcomes, or the reduction in negative outcomes. In the process, the presence of highly accomplished children and families is overlooked, and negative stereotypes are reinforced. Analyses such as these are important for both practical and theoretical reasons. In the Transition Demonstration Project, for example, the children who scored in the upper 3% of this former Head

TABLE 21.1 Data Collection Schedule for National Transition Development Project

Procedure	Functional Domain(s) Addressed	Data Collection Period				
		F ^K	S ^K	S ¹	S ²	S ³
Peabody Picture Vocabulary Test	Communication	X	X	X	X	X
Woodcock-Johnson: Reading Achievement	Academic Skills	X	X	X	X	X
Math Achievement		X	X	X	X	X
What I Think of School	Motivation and values, related to school and self-concept		X	X	X	X
Writing Sample	Academic skills and communication				X	X
Information from Family						
Getting to Know Your Family	Motivation, expectations, values, and social support	X				
Family Background Interview (updated annually)	Survival resources, health, security, basic skills, and community context/resources	X	X	X	X	X
Family Resource Scale	Survival resources, security, and social support	X				X
Family Routines Questionnaire	Family context	X				X
Primary Caregiver Health: Depression Screen	Health and security	X			X	X
Social Skills Rating System: Social Skills	Basic skills	X	X	X	X	X
Problem Behavior					X	X
Your Child's Health and Safety	Social and health services in the community context and survival resources	X				X
Parenting Dimensions Inventory	Parent-child transactions and mediating processes		X	X		X
School Climate Survey	School context		X	X	X	X
Neighborhood Scales	School context		X	X		X
Your Child's Adjustment to School	Self-concept, motivation/expectations/values (related to school), social support, and basic skills		X	X	X	X
Family Involvement in Children's Learning	Demonstration program context and school program context				X	X
Information from Teachers						
Child Health Questionnaire for Teachers	Health		X	X	X	X
School Climate Survey	School context		X	X	X	X
Social Skills Rating System: Social Skills	Basic skills		X	X	X	X
Problem Behavior			X	X	X	X
Academic Competence			X	X	X	X
School Survey of Early Childhood Programs (Part C: 1-9)	School context		X	X	X	X

(continued)

TABLE 21.1 *Continued*

Procedure	Functional Domain(s) Addressed	Data Collection Period				
		F ^K	S ^K	S ¹	S ²	S ³
Information from Principals						
School Climate Survey	School context		X	X	X	X
School Survey of Early Childhood Programs (Part A: 1–6; Part B: 1–5)	School context		X	X	X	X
Information from Existing Records						
School Archival Records Search	Basic skills and school program context		X	X	X	X
Information from Classroom Observation						
Assessment Profile for Early Childhood Programs	Classroom context		X	X	X	X
ADAPT (to measure use of developmentally appropriate practices in the classroom)	Classroom context		X	X	X	X

Start sample on individually administered standardized tests of vocabulary, reading, and math came from all ethnic groups and many sites; these children also were highly accomplished by national norms, not just project norms. In addition to their academic achievements, these children were thriving socially and emotionally as well, according to both teacher and parent ratings (although, interestingly, parents did not rate their children as more cooperative). The social ecological factors contributing to the positive outcomes for these children included some predictable, and some unexpected, factors. For instance, parents reported significantly fewer stressors in their lives, but they did not report significantly more family strengths. Residential stability, somewhat higher father involvement, fewer single-parent households, and higher rates of parent high school graduation were predictably associated with higher-achieving children. Unexpectedly, however, rates of maternal depression did not differ for the highest-achieving versus remaining children (25% versus 23%), and parental Nurturance and Consistency (factor scores from the Parenting Dimensions Inventory; Slater & Power, 1987) were comparable for these groups. What was important were the dimensions of parent Responsiveness and Nonrestrictiveness, such that children whose parents endorsed less restrictive parenting practices and were more responsive to individual child needs had children with higher academic achievement. Further, teachers rated parents of the highest-achieving former Head Start students as more strongly encouraging of their children to succeed in school, despite the fact that the

parents did not so describe themselves. Parents of the highest-achieving children did not report discussing school with their children, being in touch with the teacher, or participating in planned parent activities at school more than other parents, but they did report volunteering more often at their child's school.

Findings such as these bring into focus the importance of differentiating subgroups or clusters of children and families within a larger at-risk population. Indeed, in this study, we identified and verified six major family types, based on the strengths and needs assessments, living in poverty (e.g., C. T. Ramey, Ramey, & Lanzi, 1998). This type of differentiation permits study of the likelihood of differential courses of development and the importance of different processes to support children having more or less positive outcomes.

Unintentional Child Injuries

Schwebel, Brezaussek, Ramey, and Ramey (2004) explored children's unintentional injury risk, the leading cause of deaths among children 1 to 18 years (National Safety Council, 2001). At the time we conducted these analyses, available data supported the view that children's impulsive, hyperactive behavior patterns served to increase risk of injury and that poor parenting might also independently increase injury risk in the same samples. Remarkably, no analyses had considered whether active, positive parenting (supportive processes) could reduce injury among children at risk because of difficult behavior patterns. Using a logistic regression approach

that considered child, parenting, and contextual factors and their possible interactions, this data set affirmed that children's hyperactivity was a strong predictor of injuries (odds ratio = 28.4). The ABCD conceptualization, however, contributed to the important additional finding that parents' report of the adequacy of their temporal resources—that is, time available to parents for desired activities, including time to be with their children—was a significant protective factor for this increased-risk group of children. Thus, the family environment and parental behavior emerged as key promotive processes. (For further findings about the National Transition Demonstration Project, see S. L. Ramey, Ramey, & Lanzi, 2004.)

Collectively, these findings provide a window on ways to study developmental pathways to alternative health and education outcomes and to consider how aspects of the child's context, initial status of the child and family, and supportive as well as harmful processes can alter the course of development and children's outcomes.

PRINCIPLES OF EFFECTIVE INTERVENTION SUPPORTED BY LONGITUDINAL RESEARCH ON CHILDREN'S HEALTH AND EDUCATION

For many decades, the single most pressing question in early childhood education was simply "Do early education and health interventions work?" There was robust skepticism that early educational interventions could alter the cumulative negative toll that poverty and other risk circumstances take on the development of young children. But by the mid-1980s, a professional consensus was reached (cf. Guralnick & Bennett, 1987) that early educational interventions can—under certain conditions—produce meaningful benefits, as reflected in the academic achievement and social progress of young children. Just as important, when early interventions fail to produce intended benefits, the likely reasons are important to understand for practice and theory. Given the cross-study consistencies in findings, we summarize findings about early educational interventions in terms of five major scientific principles (C. T. Ramey & Ramey, 1998a; S. L. Ramey & Ramey, 1992). We postulate that these principles are likely to hold true for health interventions, although there is scant scientific support from randomized controlled trials designed to improve the physical health of at-risk children or to pre-

vent prevalent childhood disorders such as asthma, obesity, depression, and chronic dental disease. We have endeavored to incorporate health examples, however, as much as possible, including several dramatic public health interventions that have altered the Community Context and Community Supports directly. These five major principles are (1) the dosage principle, (2) the timing principle, (3) the direct receipt of services principle, (4) the differential benefits principle, and (5) the continuity of supports principle.

The Principle of Dosage

Programs that provide higher amounts of intervention (i.e., full dosage) produce greater benefits in health and education outcomes. This principle of dosage or intervention intensity has considerable scientific support, derived from cross-study comparisons of magnitude of benefits from multipronged and educational interventions that varied in their dosage, as well as some experimental studies that directly tested different dosage levels within the same study, and from post hoc analyses that analyzed rates of participation using sophisticated analytical techniques. Dosage is indexed in different ways, for different types of interventions; we caution that for medical interventions, the intensity principle refers to administering the full dosage, recognizing that overdosage could be dangerous.

For educational interventions in the first 8 years of life, dosage can be indexed by variables such as number of hours per day, days per week, and weeks per year that children receive the educational intervention. An ideal measure—which has never been calculated, to our knowledge, in educational interventions—would be the actual amount of instructional and learning time children have when they attend, multiplied by the child's attendance. Theoretically, the reason that more intensive programs produce significantly larger positive effects than do less intensive programs is straightforward: Children are engaged in more learning, which in turn supports their continued growth and development in the domains in which the learning occurs. For health, the greater the amount of time spent in health promotion activities and the greater the compliance with recommended health care treatments (representing a complex interplay of availability, accessibility, and acceptability of appropriate services), the healthier the child should be.

Many early interventions do not significantly improve children's intellectual or academic performance

(see S. L. Ramey & Ramey, 2000, for discussion of some reasons why these likely fail). A key characteristic of many of these unsuccessful interventions is that they were not very intensive. For instance, none of the 16 randomized trials of early interventions for young children with disabilities or delays evaluated by the Utah State Early Intervention Research Institute (White, 1991) provided full-day 5-day/week programs, and none of these programs produced any measurable benefits for children in terms of their competencies. Similarly, Scarr and McCartney (1988) provided intervention only once per week to economically impoverished families in Bermuda in an effort to replicate the findings of Levenstein's (1970) Verbal Interaction Project. They also failed to detect any positive cognitive effects.

In marked contrast, two RCTs conducted in North Carolina using the same educational curriculum, the Abecedarian Project and Project CARE, produced multiple significant benefits to participants in this high-dosage educational intervention. The Abecedarian Project and Project CARE both provided educational supports to children within a full-day, 5 days a week, 50 weeks per year program for 5 consecutive years, using a structured and individualized curriculum delivered in a high-quality, university-based child development center that was continuously monitored and supported for quality of curriculum implementation (C. T. Ramey & Ramey, 2004a, 2004b, 2004c). To our knowledge, these two programs are among the most intensive (high dosage) that have been subjected to rigorous experimental study, and the principle of dosage may account for a large portion of the increased magnitude of benefit detected at ages 8, 12, 15, and 21 years. We particularly note the benefits for language and literacy, as demonstrated in significant gains at every age on every language measure and all reading assessments (C. T. Ramey et al., 2000; C. T. Ramey & Ramey, 2004c). Other educationally important outcomes include markedly lower rates of placement in special education, reduced from 48% in the comparison group to 12% in the educational intervention group (close to the national average of 11%), and reduced rates of grade repetition, from 56% in the control group to 30% in the educational group.

The Milwaukee Project was an RCT that produced large, immediate benefits in intelligence and language (Garber, 1988) and provided a high-dosage, daily early educational intervention from birth through the transition to school, with a university child development program offered daily (see review by S. L. Ramey & Ramey,

2000). However, long-term benefits were not sustained to the same degree as in the North Carolina projects, perhaps because of the influence of the principle of continuity of supports and the differences in the enrollment criteria across these projects (i.e., the North Carolina projects enrolled on a combination of family risk variables; the Milwaukee Project enrolled only children born to mothers with mental retardation).

Two studies provide experimental evidence that program intensity matters: An early intervention home visit program (Powell & Grantham-McGregor, 1989) that systematically tested different levels of intensity discovered significant cognitive benefits at a dosage level of three visits per week, whereas fewer visits per week did not produce any significant gains, and the Brookline Early Education Project (Hauser-Cram, Pierson, Walker, & Tivnan, 1991) reported that only the most intensive services were sufficient to benefit children from less well-educated families, whereas the lowest and intermediate intensities had no measurable consequences.

The eight-site Infant Health and Development Program RCT systematically investigated program intensity effects at the level of the individual child's participation. Originally, C. T. Ramey et al. (1992) reported that the intensity of educational intervention each child and family received related significantly to cognitive outcomes at age 3. Dosage was a sum of three program components: total days the child attended the child development center between 12 and 36 months; number of home visits from birth to age 3; and number of monthly educational meetings the parents attended. This "participation index" demonstrated a strong, linear relationship to the child's intellectual and behavioral development at 36 months, even after controlling for variables that might have influenced individual rates of participation (such as maternal education, maternal verbal competence, family income, child health status, and ethnicity). When considering the efficacy of this 3-year, multipronged educational intervention to prevent mental retardation (IQ less than 70 points) at age 3, the results showed that children in the highest participation group had nearly a nine-fold reduction in the percentage of low-birthweight children who were mentally retarded (under 2%), compared with control children who received only high-quality pediatric follow-up services (about 18%). Later, Blair, Ramey, and Hardin (1995) demonstrated that year-by-year participation rates produced significant and independent effects on the course

of the child's measured cognitive competence at 12, 24, and 36 months of age.

Hill, Brooks-Gunn, and Waldfogel (2003) extended these intensity analyses to answer the question "Do longer-term effects, at ages 5 and 8, relate to participation rates?" When the children were 3, 5, and 8 years of age, multiple assessments of language and cognition were completed, with the 8-year battery including the full Wechsler Intelligence Scale for Children (WISC; Verbal, Performance, and Full-Scale IQ scores), the Woodcock-Johnson Reading and Math assessments, and the Peabody Picture Vocabulary Test-Revised (PPVT-R). On 12 major outcome measures across 3 age periods, all measures showed higher performance for children in two higher-participation groups (attending more than 350 days and attending more than 400 days in the child development center) relative to the randomly assigned follow-up group, which received pediatric and social services, but not the educational component of this multipronged early intervention. The first set of analyses confirmed that children who participated at higher rates differed significantly from the comparison group, with site-specific differences in which variables (e.g., maternal ethnicity, maternal education, maternal use of drugs, and prenatal care) correlated with amounts of participation. Accordingly, this team applied a sophisticated set of data-analytic techniques that are well-known in medical RCTs, involving an adaptation of a propensity score matching procedure coupled with logistic regression to reduce the influence of the natural selection bias when evaluating treatment effects. The results yielded compelling support for the dosage principle, demonstrating differences between matched high-dosage and control children, and between higher- and lower-dosage children within the treatment group. The magnitude of these differences is impressive at all 3 ages analyzed, and extends to the reading and math scores at age 8, with sustained benefits of the early educational intervention corresponding to gains of 6.1 to 11.1 points higher (depending on the definition used for high dosage) on the Woodcock-Johnson, as well as sustained (although slightly reduced) benefits at ages 5 and 8 for PPVT (4.1 to 6.6 points at age 8) and WISC IQ scores (6.5 to 8.4 points at age 8).

The Principle of Timing

Generally, when interventions begin earlier and continue longer, they produce larger and longer-lasting benefits to the participants than do those that begin

much later and do not last as long. The age when children enter early educational interventions ranges from birth through 8 years of age. Typically, children from economically disadvantaged families become eligible for early educational interventions (e.g., Head Start, public school pre-K for at-risk children) in their home communities beginning at 4 years of age, and sometimes at 3 years of age. Many of the well-cited early educational interventions, however, began when children were young infants, such as the Abecedarian Project (C. T. Ramey, Bryant, Campbell, Sparling, & Wasik, 1988; C. T. Ramey, Yeates, & Short, 1984), the Brookline Early Education Project (Hauser-Kram et al., 1991), the Milwaukee Project (Garber, 1988), Project CARE (Wasik et al., 1990), and the Infant Health and Development Program (1990). Two noteworthy exceptions, however, are the Perry Preschool Project, conducted in Ypsilanti, Michigan (Schweinhart & Weikart, 1983), and the Early Training Project (Gray, Ramsey, & Klaus, 1982), which began when children were 3 years of age. An important difference in these two interventions that began later in life and did produce significant benefits is that the children were documented to be significantly delayed in their cognitive development at age 3, whereas the other studies that enrolled children earlier sought to prevent intellectual decline linked to early and continued impoverished language and learning environments.

The principle of timing has always been one of high interest and is associated with vigorous debate. Concerning neurobiology and education outcomes, the stunning technology advances to document brain growth and development, coupled with research on early brain development (primarily experimental animal research) and how experiences shape brain activities lend support, in a general way, to the principle that earlier and more sustained educational interventions are especially promising to maximize benefits to children. Even the carefully controlled animal experiments on early experience, which support the general principle of timing, do not refute the possibility that educational interventions begun at later ages can produce measurable gains (S. L. Ramey & Sackett, 2000). One of the most consistently cited areas that lend support to the principle of timing comes from the observational research of Kuhl, Tsao, and Lih (2003) concerning acquisition of speech and language perception, demonstrating that an infant's exposure (naturally) to his or her first language results in the loss of a generalized discrimination ability that existed at earlier ages. This reflects development (see

earlier definition) in which there is increasing selective differentiation and hierarchical integration, that is hypothesized to facilitate (and to reflect) more efficient, higher-order functioning. When young infants are not exposed to certain sensory-perceptual experiences very early in life, they seem to lose their initial capacity (such as the universal ability of young babies to recognize phonemes in all languages, later narrowing to recognize primarily phonemes in their native language).

Just as we cautioned earlier regarding possible negative effects of overdosage, we recognize that certain types of interventions may be infeasible, ineffective, or even iatrogenic (producing unintended negative consequences) if provided too early. There are some historical examples of this, often given in textbooks, such as a study that trained babies to walk earlier than usual by practicing the walking reflex daily, and efforts to teach complex motor skills to nursery school children. Both studies found short-term changes, but these seeming benefits were washed out when the age-typical display of these motor skills occurred for the control (untreated) children.

The Abecedarian Project involved a two-phase educational intervention, with 50% of the children who received 5 consecutive years of early educational intervention and 50% in the control group (receiving nutritional, pediatric, and social services only) who were randomly selected to participate in an elementary school Home-School Resource Program for 3 consecutive years. This partially tested the issue of timing, offering extra educational supports during the school year (provided by individualized assistance to children and their families with schoolwork and school-family communication) and a summer educational camp that sought to increase children's learning opportunities from kindergarten through entry into third grade. The results demonstrate two clear sets of findings. First, the elementary school support program (i.e., the later onset of intervention) did yield measurable benefits to participants, as indexed by higher scores on standardized assessments of reading and math achievement at age 8. However, there were not comparable gains on general tests of intelligence or language, compared to children who received the preschool early education intervention. Second, the magnitude of benefits, even for the reading and math achievement scores, was smaller than for children who received the earlier-onset education intervention (see C. T. Ramey et al., 2000). This study is not germane, however, in helping to resolve the vital

question about differential timing benefits during the preschool years. Further, this study tested a reasonably well-designed and replicable public school enhancement program, but did not seek to directly control the overall classroom curriculum and instruction and thus is not a simple and pure test of timing effects alone.

In summary, the principle of timing has modest support from human studies, but further research is needed for conclusive evidence about its importance for different aspects of language, literacy, and other academic competencies. For health interventions, examples among deaf children such as timing of cochlear implants and age of teaching infants sign language confirm the greater malleability or recoverability of the brain when such corrective procedures are implemented. In general, early detection and treatment are so widely accepted as positive in health care that they rarely are studied systematically. There are no compelling data, at this time, to support the notion of an absolute critical period, such that educational intervention or health supports provided after a certain age cannot be beneficial at all; rather, this is a principle of *relative* timing effects.

The Principle of Direct Receipt of Services

This principle affirms that early educational and health interventions that directly alter children's daily health and education produce larger positive and longer-lasting results than do those interventions that rely primarily on indirect or pass-through routes to change competencies.

Early education and health interventions have been presented in many different forms, including those that are based in child development centers with trained teaching and health staff, those that are home-based and seek to change parents' health behavior and provide environmental enrichments (books, learning games, educational videos), and those that combine center- and home-based components. These different types of early educational and health interventions may be divided into two major categories: those that rely primarily on direct provision of academic and health instruction to children and those that seek indirect means of enhancing child learning, such as seeking to change the parents' behavior and, through that mechanism, to alter the child's health and education.

The empirical findings regarding the differential effects of these two quite different strategies are clear: The indirect interventions that seek to change intermediary factors are not as powerful in changing children's

language, reading, intellectual, or health performance (Lewis, 1984; Madden, Levenstein, & Levenstein, 1976; C. T. Ramey, Ramey, Gaines, & Blair, 1995; Scarr & McCartney, 1988; Wasik et al., 1990). This generalization holds true for economically disadvantaged children, seriously biologically disadvantaged children, and high-risk children with both environmental and individual risk conditions.

C.T. Ramey, Bryant, Sparling, and Wasik (1985) conducted the first systematic and experimental study with direct provision of instruction versus intermediary forms of early educational intervention. In an RCT, high-risk children were randomly assigned just after birth to receive one of three interventions: (1) the daily, highly intense child development center program, identical to that provided to children in the Abecedarian Project, coupled with the home visiting program; (2) a home visiting (intermediary) program that lasted for 5 years, used the same educational curriculum as the center-based intervention, and sought to have parents deliver the intervention; and (3) a comparison group that received enhanced nutritional, pediatric, and social services only (both intervention groups also received these health and social support services). An important achievement in this study, the longest-lasting home visiting program we know of, is that participants in all three groups remained highly engaged in the program and the assessments. The home visiting was planned to be weekly during the first 2 years of life and then every other week for the next 3 years. Further, the home visitors received ongoing supervision and continuing support throughout the 5 years and used a structured but adaptable curriculum, and both the home visitors and the families reported that they perceived the home visiting program to very positive. Despite the enthusiasm for the effort to change parents, who in turn could transmit increased learning opportunities to their children, the outcome data demonstrated no measurable gains for the children in the home visiting program compared to the control children, and both of these groups fared significantly worse than the group that received the daily, year-round center-based educational curriculum plus home visiting. Post hoc analyses indicated that magnitude of benefits associated with the children who received direct language and academic instruction (in the center) plus the 5 years of home visiting was almost identical to that reported for the Abecedarian Project participants, who did not receive the same intensive home visiting educational component. On a promising

note, from another home visiting program, Powell and Grantham-McGregor (1989) indicated that three home visits per week—but not less—produced significant child improvement through the intermediary or indirect intervention approach.

Just recently, Olds et al. (2004) reported positive but modest education and health benefits from a nurse home visiting program detected 2 years after the program ended but not during the program. These results were particularly noteworthy in the areas of receptive language and intelligence. These high-risk children were also more likely to have been enrolled in formal out-of-home care, so it is not clear whether a direct or indirect route of influences or a combination best accounts for the results.

There clearly is popular appeal to the idea that increasing the skills and knowledge of young children's first teachers—their parents—will be beneficial, because parents are children's natural support system and, typically, care deeply about their children's well-being. Also, most programs hope that changing parents and improving the home environment will have spillover effects to the next children born into these families and will help to increase the local community's competence in providing the right types of education and health experiences, at the right times, for many other young children. Increasingly, many of these parent-focused educational and health interventions consider that some parents themselves lacked good educational and health opportunities when they were growing up, and some parents lacked positive parenting models in their own lives. Accordingly, the curricula used for the parenting and home visiting programs often address the parent's own developmental needs and crucial aspects of culture and local community, along with "how to parent" issues.

What are the likely reasons that center-based programs with more traditional types of language enrichment, health care, and teacher-provided instruction relating to academic skills yield positive results in terms of academic achievement and cognition, whereas the indirect or intermediary programs do not? We hypothesize that at least four factors may be contributing to this pattern of results. One is that most home visiting programs are not equal in intensity or dosage to the center-based programs. Another is that the natural language and academic skills of some parents in at-risk families may not be equal to those of teachers or caregivers in the center-based programs, even when parents are encouraged to provide more language and academic learning

experiences to their preschool children. Thus, the children in the two groups would not receive similar levels of exposure to a rich language environment on an everyday basis (cf. Hart & Risley, 1995; Huttenlocher, 1990). A third reason is that parents who respond positively to the home visiting still may not spend enough time with their children for the children to have the full benefit of their parents' increased skills. For many parents, their children may be in the care of others for extended periods during the day or night, and these other caregivers may not be meeting the needs of these at-risk children (National Institute of Child Health and Human Development [NICHD] Consortium for the Study of Early Child Care, 2005). Fourth and finally, the rate at which participating parents acquire and then implement their enhanced parenting and instructional skills may not be rapid enough to achieve the intended benefits for their children. This harkens back to the principles of both dosage and timing. We note that home visiting programs may serve other valuable purposes, such as preventing child neglect and abuse and increasing children's health and safety, as demonstrated in research projects such those by as Olds and colleagues (2004).

For reasons we do not fully understand, the early childhood community has become polarized around issues that concern direct or explicit teaching of certain skills to young children. It appears common knowledge that babies are born without knowing any specific words or ideas, and that skills related to reading, writing, and math require direct exposure; that is, their advancement cannot occur without some introduction, scaffolding, modeling or demonstration, and practice and feedback. We believe that some practitioners in early childhood programs mistakenly tried to enact kindergarten-or first-grade-level instruction for much younger children, and adopted ineffective methods of repetitive drill, restricted young children's spontaneous play and exploration, and tried to force very young children to attend and behave in ways that were counterproductive. Accordingly, the anti-instruction movement could be viewed as a backlash to such inappropriate applications of early educational interventions. An alternative explanation is that some of the competent caregivers for young children, particularly low-income and minority children, in the United States have low levels of formal education and lack formal teaching credentials. There may be a fear that all of these individuals will be excluded from the future of child care and early education and judged to be incompetent simply because they can-

not articulate precisely how they instruct children and help to prepare them for school. Although there are many published studies documenting a general relationship between an adult's level of education, language skills, and intelligence and the adult's skills in promoting children's cognitive and language development (cf. NICHD Consortium for the Study of Early Child Care, 2005), there are many notable exceptions to the generalization. From our own professional experience, we have observed highly competent teachers of young children who come from all types of educational backgrounds and all types of linguistic and cultural backgrounds. Advanced degrees in early childhood education are not a guarantee of high-quality instruction occurring on a responsive and regular basis; neither does the lack of a college degree prohibit an adult from providing high-quality language and academic learning opportunities.

Currently, the Institute of Educational Sciences is coordinating an effort to evaluate RCTs that test the benefits of different published preschool curricula, mostly for 4-year-olds. This effort is designed to yield much needed information about "what works" in pre-K settings. There are, however, already recognized limits that have surfaced in this new research endeavor, such as differences across sites regarding the dosage of the intervention (hours per day, weeks per year), the degree of risk in the children participating, the quality of and control over curriculum implementation, and the levels of participation from the children and families. What is admirable about this research initiative is that both educational science and curriculum development are being advanced, and the practical importance of this type of scientific inquiry has become paramount by creating a national network of projects concerned with children's language and literacy outcomes. Content analysis of existing early educational interventions that have already produced large and lasting benefits through RCTs would be a worthwhile endeavor, as well as efforts to measure the actual classroom instruction at levels that correspond to the particular types of learning and language experiences hypothesized to be the most essential for young children's learning (e.g., C. T. Ramey & Ramey, 1999; S. L. Ramey & Ramey, 1998).

The Principle of Differential Benefits

This principle asserts that some children show greater benefits from participation in early educational and health interventions than do other children. These indi-

vidual differences appear to relate to aspects of the children's initial risk condition and the degree to which the program meets the child's needs or services to prevent the harmful consequences of those risk conditions over time (e.g., by providing sufficient amounts of direct positive learning experiences that otherwise would not have been present).

A fundamental assumption in the fields of education and social ecology is that of person \times environment (read as "person by environment") or person \times treatment effects. This assumption is that different individuals respond differently to the same program, and correspondingly, different programs may be needed to produce the same outcome for different participants. These ideas have long prevailed in the clinical and educational literature, but only recently have they been explored systematically in the early intervention field.

In providing broad-based early intervention for premature, low-birthweight infants, the Infant Health and Development Program (1990) reported that children at greater presumed biological risk, as indexed by their lower birthweight (less than 2,000 gm), at age 3 years did not initially benefit as much from the program as did children at lesser presumed risk (with birthweight between 2,000 and 2,499 gm), even though both groups showed significant gains. In a longer-term follow-up of these children at 5 and 8 years of age, Hill et al. (2003) reported large and significant risk \times intervention effects, such that the heavier low-birthweight children showed IQ point benefits of about 14 points, and lighter babies had effects of about 8 points, compared to their appropriate-birthweight matched controls who did not receive the educational component of the intervention.

Another study focused on early educational intervention for children with disabilities and considered two influences simultaneously: the degree of the child's impairment and the form of educational intervention provided. Cole, Dale, Mills, and Jenkins (1991) found an aptitude \times treatment effect in a randomized design comparing Feuerstein's "mediated learning" techniques and more traditional direct instruction. Contrary to conventional wisdom, students who performed relatively better (as measured on the pretest battery of cognitive, language, and motor tests) gained more from direct instruction, whereas students who performed worse showed greater benefits from the mediated learning treatment.

From the Abecedarian Project, Martin, Ramey, and Ramey (1990) discovered that the children who showed the greatest relative gains (i.e., compared to controls)

were those whose mothers were the most intellectually limited (i.e., maternal IQ scores below 70; in fact, all experimental children whose mother was mentally retarded performed at least 20 points higher and averaged 32 points higher than did their own mother; Landesman & Ramey, 1989). These dramatic findings are comparable to the large benefits reported in the Milwaukee Project, which enrolled only economically disadvantaged mothers with IQs below 75 (Garber, 1988).

Some of the programs that have failed to detect any significant overall benefits may have enrolled a highly heterogeneous group of children, some of whom were at very low or no risk for poor educational outcomes. This could serve to lessen the power to detect real intervention effects if, in fact, only the high-risk children showed benefits. As an example, analyses conducted on children participating in the Infant Health and Development Program showed significantly different levels of benefit based on the educational level of the children's mother. As Figure 21.3 shows, the degree of benefits, as indexed by children's IQ scores on the Stanford-Binet at age 3, displayed a highly orderly relationship to mother's education. The gains were the greatest (comparing treated and control children) for those children whose mother had less than a high school education, followed by those whose mother earned a high school

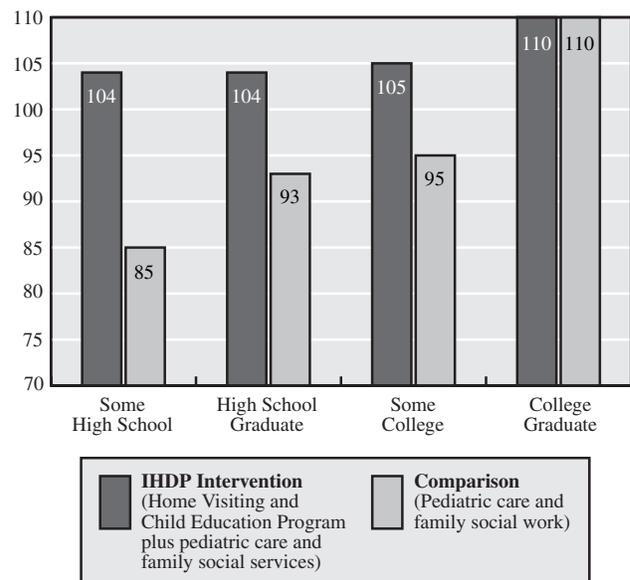


Figure 21.3 Differential effects of the Infant Health and Development Program on age 3 IQ outcomes (Stanford-Binet) as a function of maternal educational status.

degree or GED, and then those whose mother had some college education. Interestingly, there were neither any benefits nor any harm related to participating in this educational intervention for children whose mother had earned a 4-year college degree or higher (see S. L. Ramey & Ramey, 2000). These findings of differential benefits are consistent with an interpretation that these educational interventions supplement children's experiences at home in ways that are essential for the development of average (or above-average) intelligence; accordingly, for children whose cognitive and linguistic development is strongly supported by their family and other natural environments, additional educational interventions are not needed to prevent subaverage performance. We also note that in this study, the control children, like those in all of the RCTs we have reviewed, were never prevented from participating in other programs, and many of the college-educated parents in the Infant Health and Development Program sought, on their own, additional help and information to support the early development of their premature and low-birthweight infants.

The Principle of Continuity of Supports

This principle states that over time, the initial positive effects of early interventions will diminish if there are inadequate later supports to maintain children's positive outcomes. This has been demonstrated mostly in the educational realm, but logically is just as important for children's health. The reason postintervention programs continue to matter is that children continue to learn at high rates, with educational and health progress that depends not only on a child's entry-level skills or health status but his or her continued acquisition of the cognitive, language, and academic skills—complemented by appropriate physical, social, and emotional skills—to have a positive transition to school (S. L. Ramey, Ramey, & Lanzi, 2004).

For many early intervention programs for at-risk children, long-lasting and substantial effects on school achievement, grade retention, and special education placement have been repeated. In some, but not all, studies (e.g., Garber, 1988), the long-term effects of early educational intervention on IQ scores lessen over time. Two important issues are relevant. First, it is not sufficient for disadvantaged children merely to maintain the advantages from effective early educational interventions. Rather, children must continue to develop at normative rates in multiple domains if they are to succeed

in school settings. Second, no currently influential developmental theory is premised on the assumption that positive early learning experiences are sufficient *by themselves* to ensure that children will perform well throughout their lives. A poor school environment, sub-optimal health, a seriously disrupted home environment, and many other conditions influence the behavior of children at all ages. Thus, longitudinal inquiry about the long-term effects of early intervention must take into consideration children's subsequent environments and experiences (i.e., after early intervention ceases).

As described earlier, only one RCT early intervention study, the Abecedarian Project, has extended early intervention into the elementary school years to evaluate the importance of additional systematic supports during the transition to school. As Figure 21.4 shows, at 8 years of age, children who had received continuous educational intervention for the first 8 years performed the best of any group in reading and mathematics, followed next by those who received early intervention for 5 years, followed by those who received the elementary school treatment only (Horacek, Ramey, Campbell, Hoffman, & Fletcher, 1987). Longitudinal analysis of IQ scores revealed effects only for the early intervention groups; that is, the supplemental program from kindergarten through age 8 did not result in higher IQ scores (C.T. Ramey & Campbell, 1994). Later, at age 12, children who had received the early intervention continued to show benefits in terms of both academic achievement and IQ scores and a reduction of nearly 50% in the rate of repetition of at least one grade in the elementary school years. Overall, however, the group of children who performed best across all measures were those who had *both* the preschool and school-age educational interventions.

Currie and Thomas (1995) have conducted important analyses of the long-term educational progress of former Head Start children and demonstrated that those who go to average or above-average schools continue to keep up with their age or grade peers, whereas those in the very lowest performing schools show a decline (relative to their school entry level). Tragically, 50 years after *Brown v. Board of Education*, it remains true that African American low-income children disproportionately attend very poor quality schools, at rates far higher than for other ethnic groups even when family income is below the poverty line.

Recently, Barnett (2004) has written an excellent and integrative review that confronts the "myth of fade-out." Although it is true that IQ scores per se show dimin-

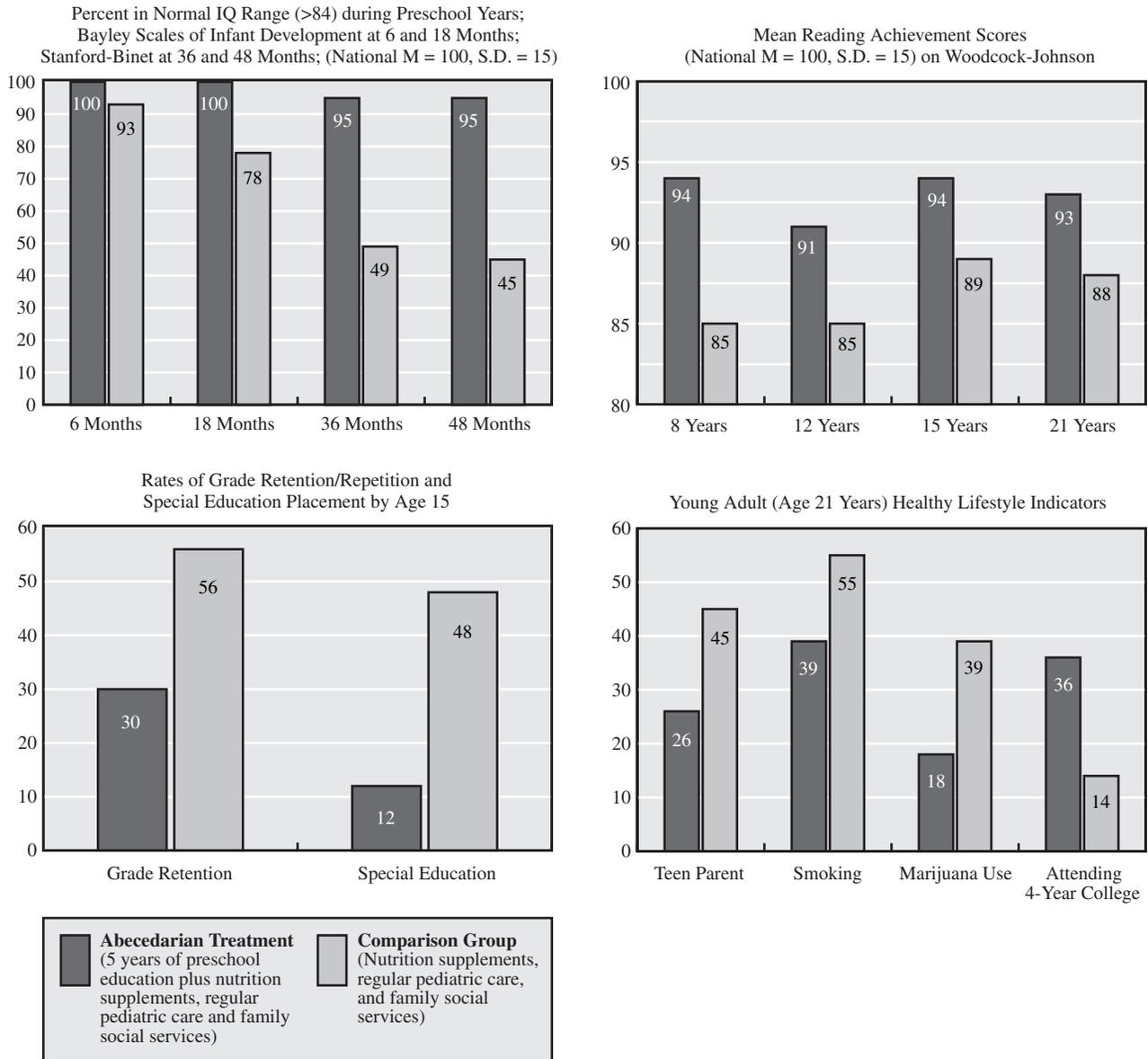


Figure 21.4 The Abecedarian Project: selected health and education outcomes from infancy through young adulthood.

ished group difference over time, achievements in reading, language, math, and overall school adjustment as indexed by grade retention and special education placement show long-lasting benefits. When these sustained effects do not appear, one of the contributing factors—in addition to the principles already detailed in this chapter—may well be the quality and intensity of the educational programs that follow the early educational intervention. The opportunity to conduct more rigorous post hoc analyses about the schools that children attended across the well-conducted RCTs that have longitudinal data would be valuable, as well as more de-

scription about the natural variation in the alignment and educational supports for children transitioning from early educational interventions into public school programs (Kagan, 1994).

KEY FEATURES OF COLLABORATIVE AND COMMUNITY PARTICIPATORY RESEARCH

Traditionally, scientific inquiry about child development has been guided primarily by scientists with interests in advancing scientific theory and practical understanding

of what influences the course of human development. Some research has been fueled by advocacy concerns, such as increased research into Autism, mental retardation, AIDS, and learning and reading disabilities. Rarely, however, is research conducted in a way that adequately includes the perspectives of those whose lives are the primary topic of the research. Further, clinicians, educators, and community members often have extensive in-depth knowledge of topics germane to longitudinal research on children and families, yet these individuals seldom participate as full partners in the design and conduct of longitudinal research. Increasingly, scientists recognize the tremendous potential value of conducting research in a way that actively engages and respects a much broader range of expertise, from multiple disciplines, practices, and community experiences. The challenge is how to efficiently and effectively create new types of partnerships in which multiple groups of "experts" can be combined to yield a more complete understanding of important influences on children's health and education.

We have established and used guidelines for conducting collaborative research to evaluate the effects of interventions in education and health settings (S. L. Ramey & Ramey, 1997b). Figure 21.5 summarizes critical activities in planning and conducting responsive, useful research on education and health interventions. Briefly, these include early engagement of key individuals and groups as participants to create a shared vision and framework to guide decision making and the identification of key questions and plans for gathering and analyzing data. Vital to the success of collaborative and community participatory research is the generation of timely interim reports that provide practical information about the progress of program implementation and early evidence about program impact and children's development. Active maintenance of these partnerships is equally important to ensure continuity in the conduct of longitudinal intervention research and to understand other changes occurring over time in the community and families' lives that may affect measured health and education outcomes. These research partnerships facilitate accurate identification of changes in the community and family context that may independently and interactively affect child health and education. These partnerships not only serve to foster scientific integrity in terms of the appropriate measurement of relevant multiple influences, but also set the stage for informed interpretation, dissemination, and application of the results of such re-

search. In addition, the partnerships themselves can serve as an ongoing means of timely exchange of relevant information, including opportunities for scientists to provide practitioners and families with valuable findings from previous research that could be practically applied in the community (see Figure 21.5).

We would be remiss if we did not state there are serious challenges associated with conducting such complex, ambitious, and action-oriented research. These include the importance of identifying the appropriate individuals who will be engaged in the partnership, recognizing that the members in the partnership will change over time (for many reasons), finding ways the partnership can offer tangible benefits and appropriate recognition to all participants throughout the partnership, anticipating and proposing how to resolve likely problems and disagreements, and creating stronger supports within most universities for this type of research. Ideally, clearly written agreements (e.g., memoranda of understanding) signed by key participants and community and university leaders, widespread public media about the partnership, and ongoing documented meetings to exchange information in ways that are open and honest serve as important mechanisms for maintaining project integrity, acceptability, and productivity.

As an example, when we created a long-term research partnership between a geographic community and a major research university, we developed and endorsed a set of guiding operating principles (for more details, see C.T. Ramey & Ramey, 1997a, 1997b). These were (a) a pledge that there will be joint university and community development of all programs; (b) a commitment to research that benefits both the community and the university; (c) a commitment to programs that make a difference in people's everyday lives; (d) a pledge from partners to maintain the partnership for an extended period (e.g., a decade); (e) a belief that over time both the community and the university will become better places as a direct result of the quality of partnership; and (f) a commitment to conducting the partnership in a way that could serve as a model for others (e.g., to expand the benefits and to facilitate productive university-community partnerships).

Universities and Public Policy

Universities have been the largest incubator for model research programs to enhance young children's education and to test health interventions. Unfortunately,

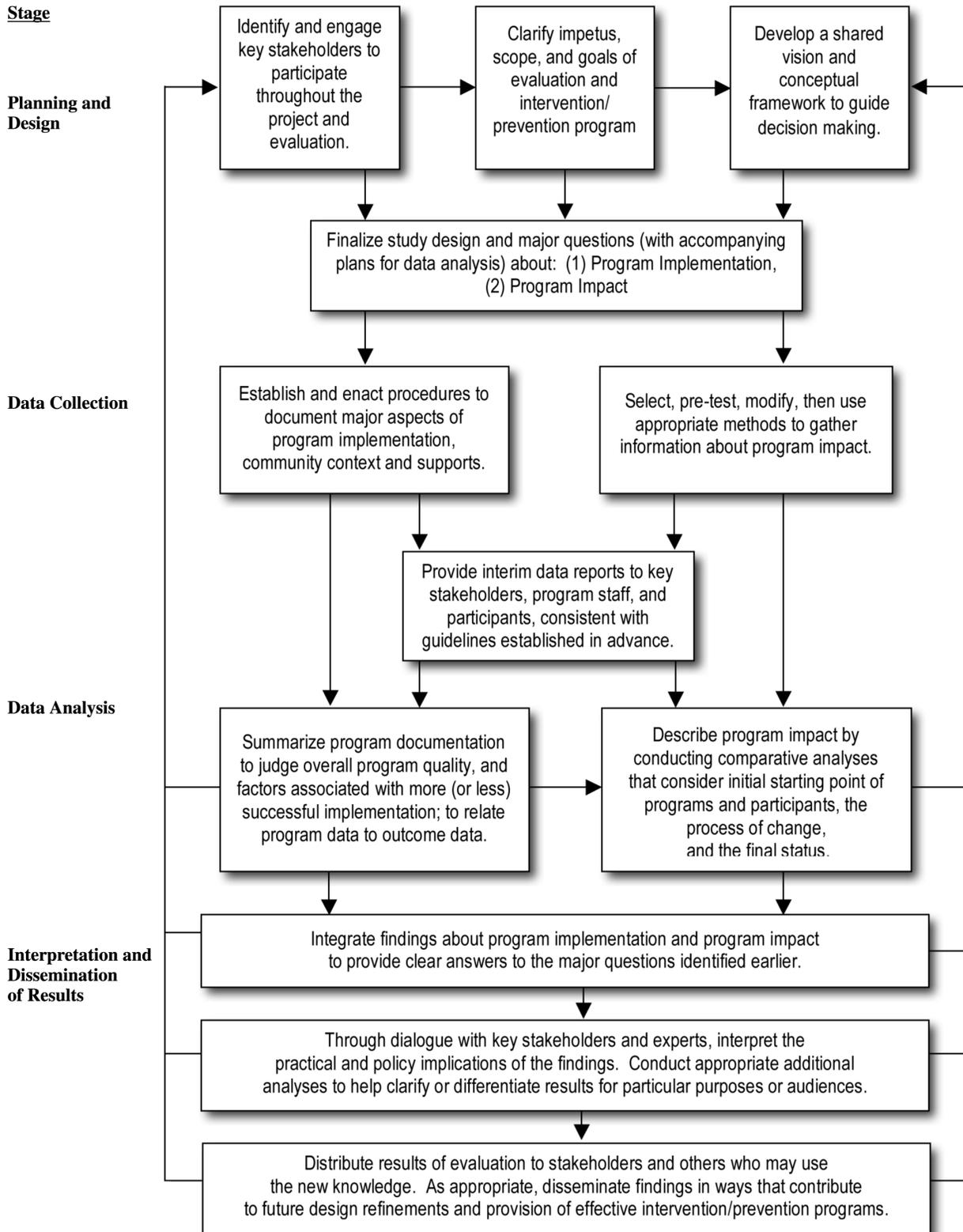


Figure 21.5 Critical activities in planning and conducting responsive, useful health and education evaluations. Adapted from “The Role of Universities in Child Development” (pp. 13–44), by S. L. Ramey and C. T. Ramey, in *Children and Youth: Interdisciplinary Perspectives*, H. J. Walberg, O. Reyes, and R. P. Weissberg (Eds.), 1997b, Thousand Oaks, CA: Sage. Reprinted with permission.

many of the model programs shown to yield positive benefits have not been adopted and implemented in community settings to realize comparable benefits on a large scale. We think this indicates an inherent limitation in the old-style research that has been primarily conducted within one or two major disciplines, led by university scientists, funded by federal agencies without requiring early and sustained engagement of key community stakeholders, and not designed to take into account public policies and practical issues that will determine whether new programs can readily be implemented in the community.

To a remarkable degree, the historical structure of universities also has guided the structure of the research funding and the ways communities are organized to provide supports for children and families (C. T. Ramey & Ramey, 1997b). Specifically, the historical disciplinary training that grants degrees in areas such as social work, psychology, pediatrics, pediatric dentistry, pediatric rehabilitation, early childhood education, special education, educational psychology, child and family nursing, child psychiatry, public health, and urban planning (and many others) contributed to the creation of parallel types of service organizations and community-based practices that have hindered the provision of well-coordinated, efficient, and comprehensive supports for children and families. This dispersion has created a remarkable fragmentation and duplication of services in a time of limited resources and high need. Similarly, within universities, a highly compartmentalized knowledge base about children and families has evolved, with no obvious way to create a unified understanding of child development and effective means of enhancing the development of the most at-risk children.

Potential benefits of reorganization within universities and communities, consistent with the scientific evidence about how children learn and how their health is promoted, are great. Just as the university-led research and demonstration projects are inherently limited, so, too, are many well-intentioned community-based programs that have not realized their intended benefits, even when they have sought to be comprehensive and coordinated. The community initiatives often do not include rigorous research from the beginning, just as many university-led efforts have not adequately included community input and partners. We think this further supports the need for major policy and organizational changes in both universities and communities—changes that will not be easy or welcomed by all. Genuine reor-

ganization would likely mean the end of some disciplines and practices as we know them today and the creation of new combined or coordinated fields and practices designed to better meet the needs of children and families in ways that are more holistic, informed by scientific findings, and responsive to communities and consumers.

This type of research also places universities in a new position, one in which they are actively supporting relationships to improve well-being in the community, while at the same time generating new knowledge. Accordingly, universities may need to consider how to strategically invest in infrastructure support for this type of research (i.e., on a par with planning for new technology and laboratory supports), how to recognize and reward faculty and staff for productively sustaining these research-service partnerships, and how to operate in more flexible and accommodating ways to promote these partnerships (e.g., creating easy-to-handle subcontracts, joint hiring or supervising of staff, reducing indirect cost rates for certain activities, flexibility in paying for community consultation, offering access to university courses and services to community partners). Finally, universities need to anticipate that the emerging results from longitudinal research may sometimes be controversial and politically charged. Ideally, the partnership agreements will have anticipated a full range of results, and active partnerships will accept responsibility for agreed-upon ways to share and act on the findings. Scientific and academic freedom cannot be compromised; neither should the needs of the community and research participants be ignored in how the findings are interpreted and disseminated. These complicated and thorny issues need to be openly discussed and considered in an ongoing fashion, consistent with the overall goal of promoting children's health and education.

SUMMARY

Both early childhood education programs and community-based prevention and health promotion interventions need to incorporate a transdisciplinary approach that builds on recent scientific findings and reflects advances in integrating the historically separate fields of health and education. This relatively new and innovative approach can be characterized as a systematic endeavor to individualize and integrate the supports provided to treat and educate "the whole child." Health is defined consistent with the

WHO definition as including an individual's psychosocial well-being, not merely the absence of disease or disability. Similarly, education is defined as more than just intellectual ability and performance on standardized measures of academic achievement; that is, a child's progress in the educational arena includes social-emotional skills, the ability to adapt to change, and a wide array of cognitive and problem-solving skills that support lifelong learning and competence.

There are many well-intentioned federal, state, and local multicomponent initiatives under way, including the well-known Head Start, Early Head Start, early intervention programs for children with developmental disabilities and risk conditions, subsidized child care quality enhancement efforts, and school readiness and transition-to-school programs. This chapter presented as an example the Head Start-Public School Early Childhood Transition Demonstration Project, a multisite, congressionally mandated intervention to help promote the educational attainment and health of former Head Start children and their classmates, based on an ideology of two-generation, community-based family support.

Children's health and education are widely recognized as vital for their success as contributing members of society, yet relatively few studies have endeavored to understand how health and education mutually influence each other and combine to determine the course of a child's development. Applied biosocial contextual development is a general conceptual framework that is strongly supported by research findings and has proven useful in designing and studying interventions to improve children's health and education. ABCD identifies multiple and co-occurring types of influences on development from a systems theory perspective. Children's development is dimensionalized in terms of biological and social processes that can be more or less supported or hindered by environmental conditions, and thus contribute to three major classes of interrelated outcomes: children's health status and health promotion behaviors (health); children's behavioral, intellectual, and social development, and their educational progress (education); and children's own internal representations of themselves, their environments, and their experiences (personal constructs).

Many carefully planned interventions have yielded scientific findings about what constitutes effective childhood interventions. We reviewed and summarized these findings by delineating five major principles of ef-

fective early intervention. The scientific principles supported by research are the following:

1. The principle of dosage, in which more intensive or higher-dose interventions yield larger and longer-lasting effects, whereas less intensive interventions often yield limited or no demonstrable benefits.
2. The principle of timing, supporting the conclusion that interventions that are well-timed to take advantage of children's neuroplasticity in multiple domains, by beginning fairly early in life and continuing through periods of rapid growth and learning, produce more positive outcomes.
3. The principle of direct receipt of supports, indicating that, to date, programs that seek to change children only by changing their parents and community providers have not produced evidence of significant benefits to children themselves, whereas programs that provide services directly to children (often accompanied by family and community supports) can alter the developmental trajectories of individual children.
4. The principle of differential benefits, which predicts that planned interventions are likely to have greater or lesser impact on children, depending on a combination of factors, such as the initial type and magnitude of a child's risks and needs and the extent to which these are specifically addressed in the intervention. For example, children whose mother has limited resources to meet her young children's cognitive and language learning needs have benefited significantly more from early educational interventions than have children whose mother initially had much greater amounts of educational, economic, and health resources.
5. The principle of continuity of supports, which affirms the importance of children receiving the right types and amounts of environmental supports for health and education throughout their development. That is, there is no evidence that early intervention programs alone can produce large and sustainable benefits in the absence of children receiving reasonably good supports from schools, families, and communities after the planned intervention.

Much remains to be learned about the ways these five major principles interact across different ages and stages of development and within and across diverse cultural and regional settings. The future of scientific inquiry

about children's health and education research will depend largely on the degree to which studies are more carefully designed, implemented, documented, and summarized in ways that can be compared and combined within a practically useful knowledge framework.

To conduct such complex research, especially involving large-scale and sustainable prevention and intervention programs, a new style of collaborative research that engages the community and broader expertise from professionals, scientists, and citizens is vitally needed. Engaging individuals and groups in the early stages of planning and implementation has great promise for producing results that are more valid, more sensitive, and more acceptable and useful to families, practitioners, and communities. Conducting such research necessitates an in-depth understanding of the complex and changing ways that policy, economics, politics, and practice operate in the fields of education and health. The goal of such research is undeniably both basic and applied, and potentially may yield insights to move into an era where the large disparities and inequities in health and education for low-income, historically marginalized groups of children are drastically reduced and eventually eliminated.

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