

Early Intervention and Early Experience

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For 4 decades, vigorous efforts have been based on the premise that early intervention for children of poverty and, more recently, for children with developmental disabilities can yield significant improvements in cognitive, academic, and social outcomes. The history of these efforts is briefly summarized and a conceptual framework presented to understand the design, research, and policy relevance of these early interventions. This framework, biosocial developmental contextualism, derives from social ecology, developmental systems theory, developmental epidemiology, and developmental neurobiology. This integrative perspective predicts that fragmented, weak efforts in early intervention are not likely to succeed, whereas intensive, high-quality, ecologically pervasive interventions can and do. Relevant evidence is summarized in 6 principles about efficacy of early intervention. The public policy challenge in early intervention is to contain costs by more precisely targeting early interventions to those who most need and benefit from these interventions. The empirical evidence on biobehavioral effects of early experience and early intervention has direct relevance to federal and state policy development and resource allocation.

Early intervention services are federally mandated in the United States for young children with developmental disabilities. Such services may also be provided to preschool children who are at risk for developmental disabilities at the discretion of the state and of local school systems. These recently mandated services are complex and continue to evolve. So too are the scientific and social forces that gave rise to the early intervention mandate, which is currently regulated by Public Law 105-17 (the amendments to the Individuals With Disabilities Education Act, 1997). In addition, many special programs are targeted for children and families at an economic or social disadvantage—most notably, Head Start (Zigler & Muenchow, 1992) and derivative two-generation intervention programs (cf. Sigel & Smith, 1995).

History of Early Intervention

The idea of early intervention was born in the shadow of *Brown v. the Board of Education*, the 1954 Supreme Court desegregation case that affirmed the universal right of all children to a decent education. Separate educational systems for Black children were judged inherently unequal. By analogy to the cultural melting pot (an image derived

from iron and steel production), integrated public education was proposed to promote social harmony and educational equity. It soon became clear that the analogy of integrated public education to the European American melting pot did not hold. Black individuals had and still have a singular position in American cultural history owing to the prejudices and practices inherent in slavery and an instantly recognizable cardinal characteristic—namely, skin color—that facilitates prejudicial discrimination.

For generations the social institution of slavery systematically denied Black men, women, and children access to schooling and literacy. De facto segregation, after slavery was abolished, also systematically reinforced disparate developmental outcomes through social neglect and underfunding of Black schools. Not surprisingly, in the wake of *Brown v. the Board of Education*, psychologists and educators discovered that newly integrated Black children were entering public schools at a cognitive and educational disadvantage relative to their White classmates. The pernicious race card was immediately played, and some social scientists used psychology's bad penny—the nature versus nurture, either-or concept of development—as an explanatory construct for these educational and cognitive inequalities. Black individuals were judged, by some, to be intellectually inferior to Whites because of genetic limitations (e.g., Jensen, 1969). The fact that this erroneous explanation is alive and socially influential even today can be seen in the popularity of Herrnstein and Murray's (1994) book, *The Bell Curve*. Another stream of social evidence flowed into this general argument in such a way as to apparently soften the perniciousness of the race card: namely, the induction proceedings for World War II, including the use of intelligence assessments for selection and assignments, which detected systematic inequalities among White men. White men from poorer, less educated sections of the country performed worse on standardized measures of intelligence than did those from more affluent and better educated sections of the country (Ginzberg, 1965).

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In 1959, during the presidential campaign, the highly popular magazine *Life* ran a haunting portrait of life in the Appalachian mountains, depicting the terrible cognitive and social life situations of poor White families in West Virginia and other predominantly Southern states in the Appalachian chain. This time, the social class card, rather than the race card, was played. Many of the early settlers in the Appalachian chain—a quite remote and inaccessible region until recently—were descendants of impoverished, lower-class English, Scottish, Irish, and Welsh immigrants. The lower-class children from the hardscrabble farms and hollows were often poorly nourished, undereducated, and cognitively delayed. Again, a convenient hereditary explanation was combined with social Darwinism to provide a psychological explanation, one that fit well with the dominant hereditary conception of intelligence associated with the psychometric tradition.

Against this view of inherited intelligence, a small group of experimentally and clinically trained psychologists, strongly grounded in learning theory, began to explore the role and consequences of early experience. Prominent theorists in early experience included Donald Hebb (1949), J. McVicker Hunt (1961), and Harry Harlow (1958), all of whom emphasized the importance of early experience for brain and behavioral development. Without denying the potential role of genetics in individual differences, each of these theorists worked on explicating the roles of early experience in cognitive, social, and emotional development.

Another group of psychologists conceptualized and conducted systematic studies involving young children and their families. Many of these investigators were influenced by the work in Iowa of Skeels and Dye (1939), who, in a methodologically controversial but seminal study, provided evidence for the power of early experi-

ence to alter the development of intelligence and the ultimate life course of institutionalized retarded children. The findings by Skeels and many others (cf. Landesman, 1990), especially when contrasted with the dominant view of intelligence as determined primarily by heredity, set the stage for larger scale, systematic early intervention studies using conventionally accepted, high-quality research designs, most notably random assignment to treatment and control groups.

Participants in the randomized trials of early enrichment were disproportionately children of undereducated and poor Black families (e.g., Caldwell, 1973; Gray, Ramsey, & Klaus, 1982; Weikart, Bond, & McNeil, 1978). This work laid the cornerstones for Project Head Start, which began in 1964 as the nation's premier public policy effort to improve the school readiness and social development of disadvantaged children (cf. Zigler & Muenchow, 1992; Zigler & Valentine, 1979).

Somewhat earlier, the United States had been startled by news that the Soviet Union launched a small satellite called Sputnik that was orbiting the earth and transmitting recordable electronic signals. That 1957 event was construed as a major technological feat with strong military, national defense, and industrial significance. Because the United States had been scooped scientifically, the U.S. educational system was judged to need serious upgrading, and the federal purse strings for education were loosened. Educational innovation became a national priority. Although educational reform in response to Sputnik centered on kindergarten–Grade 12 and university education, a zeitgeist was established that positively affected the social policy climate for preschool early intervention. It legitimized, by precedent, the federal role in creating Head Start and other two-generation intervention programs for children of poverty and, more recently, in creating the early intervention system for children with developmental disabilities.

Early Intervention: Theory and Practice

Early intervention is a term that refers to a broad array of activities designed to enhance a young child's development. Ideally, early intervention starts with a comprehensive assessment of the child's and the family's strengths and needs and extends through the provision of appropriate supports and services to active monitoring and reevaluation as the child develops. In practice, there is tremendous variation in what comprises early intervention. The scientific and practitioner literatures on early intervention are dichotomized on the basis of program participants: children judged at risk for poor developmental outcomes versus children with identified developmental disabilities or developmental delays. The programs targeted for at-risk populations often are conceptualized as preventive interventions, whereas those serving children with known problems are considered treatment programs (S. L. Ramey & Ramey, 1992). The terminology of early intervention is far from precise or standardized, although within particular policy arenas and service delivery systems, particular terms convey legal and prac-

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tical meaning (C. T. Ramey & Ramey, 1996). A brief history of federal legislation is informative.

In 1975, Congress passed landmark legislation to ensure that all children would receive a free and appropriate education. Known originally as The Education for All Handicapped Children Act, this led to the creation of a complex special-education system throughout the United States (cf. Schroeder, Schroeder, & Landesman, 1987). Over the years, the reauthorization of this legislation, now titled the Individuals With Disabilities Education Act, or IDEA, has included dramatic reforms. First, public school systems were mandated to serve children with disabilities starting at age three—several years earlier than schools typically provide universal education. Next, this legislation created an option for states to serve children from birth through three years of age (referred to as *Part H* services from 1987 to 1996 and now reclassified as *Part C* under the 1997 reauthorization). This led to the creation of a large interagency array of services and supports in all 50 states and U.S. territories, broadly referred to as *the early intervention system*. All infants and toddlers with diagnosed developmental disabilities¹ are eligible for early intervention. In addition, states have the option to extend early intervention supports to children considered at risk (e.g., very low birth weight infants, children born to mothers with mental retardation, children from multirisk families). This federally initiated early intervention system was fueled by the combined efforts of parents, advocacy organizations, and early childhood specialists who recognized the primacy of early experience and the potential to prevent secondary conditions attributable to inadequate treatment of primary conditions.

An independent line of Congressional legislation contributed to the establishment of children and family

supports for those living below the federal poverty level. The best known and funded interventions fall under the Head Start legislation and include Head Start programs for three- and four-year-olds, Parent and Child Centers, the Comprehensive Child Development Programs, and the recently funded Early Head Start programs for infants and toddlers. In 1996, Head Start spent \$3.6 billion to serve more than 750,000 children, 68% of whom were between four and five years old. An interesting feature of Head Start is that all programs must include children with disabilities—a minimum of 10%—although Head Start's definition of disabilities differs from that used by the Department of Education and IDEA. Furthermore, Head Start children with disabilities do not need to meet the family income eligibility criterion (i.e., living in poverty at time of enrollment).

In addition to these two major independent federal initiatives in early intervention, there are literally hundreds of early intervention programs funded by local, private, and other federal sources, encompassing home-visiting programs and center-based programs for high-risk children and families (e.g., Coie et al., 1993; C. T. Ramey & Ramey, 1996; Roberts, Wasik, Casto, & Ramey, 1991).

The Rationale for Early Intervention

The Centers for Disease Control and Prevention now estimate that over 300,000 individuals under 21 years of age in the United States are so poorly developed cognitively as to have mental retardation (IQ below 70), which, on the basis of the epidemiological catchment area survey by Boyle, Decoufle, and Yeager-Allsopp (1994), might have been prevented through early and continuing intervention. This survey revealed that risk for both mental retardation and poor school readiness is highest among children from families with the lowest socioeconomic status, particularly among those whose mothers' education is below the 10th grade. Furthermore, many more children enter public school unprepared to meet the intellectual demands of school. Lack of school readiness bodes ill for future school performance. Poor school readiness predicts increased likelihood of low levels of academic achievement and high levels of retention in grade, special-education placement, and ultimately school dropout. These same children are at elevated risk for teen pregnancy, juvenile delinquency, unemployment, social dependency, and poor parenting practices. The children of school dropouts all too frequently repeat this

¹ The U.S. government defines *developmental disability* as a severe, chronic disability of a person that (a) is attributable to a mental or physical impairment or a combination of the two; (b) is manifested before the person attains the age of 22; (c) is likely to continue indefinitely; (d) results in substantial functional limits in three or more of the following areas of major life activity: self-care, receptive and expressive language, learning, mobility, self-direction, capacity for independent living, or economic self-sufficiency; and (e) reflects the person's need for a combination and sequence of special interdisciplinary or generic care, treatment, or other services that are of lifelong or extended duration and are individually planned and coordinated.

intergenerational pattern (cf. Carnegie Task Force on Meeting the Needs of Young Children, 1994).

Early intervention is deemed essential to prevent mental retardation and poor intellectual development in children whose families do not provide adequate stimulation in the early years of life. The mounting evidence about the significance of early experience in brain development, recently summarized in *Rethinking the Brain: New Insights Into Early Development* (Shore, 1997), provides a stronger than ever impetus for systematic efforts to enhance children's learning opportunities and development in the first three years of life.

Concerning children with diagnosed disabilities, the rationale is that their modes and rates of learning are likely to require specialized strategies to ensure healthy development. Despite the lack of unequivocal scientific evidence, parents and practitioners have witnessed dramatic shifts in the competency of children such as those with Down syndrome, spina bifida, hearing and visual impairments, and autism when they participate in intensive, systematic early intervention programs. These anecdotal and personal experiences, coupled with parents' great need to receive information about how best to meet their children's special needs, have been sufficient to justify continued expansion and improvement of early intervention for the heterogeneous group of children with developmental disabilities.

Figure 1 illustrates the theory that children's experiences can alter their intellectual competence over time. A major challenge faced by schools is that remedial programs for children who have had inadequate supports in the first five years of life need to accelerate children's

rates of development if true catch-up is to occur. That is, when children participate in appropriate, powerful programs to help compensate for their delayed or suboptimal development, they need to acquire missing skills that age-mates are rapidly gaining. Furthermore, the practical limitations of such remedial programs in terms of the hours available, relative to children's total waking hours, are daunting. Indeed, that is one of the reasons why almost all early intervention programs, as well as later school-based programs, seek to engage families as active partners in their children's learning.

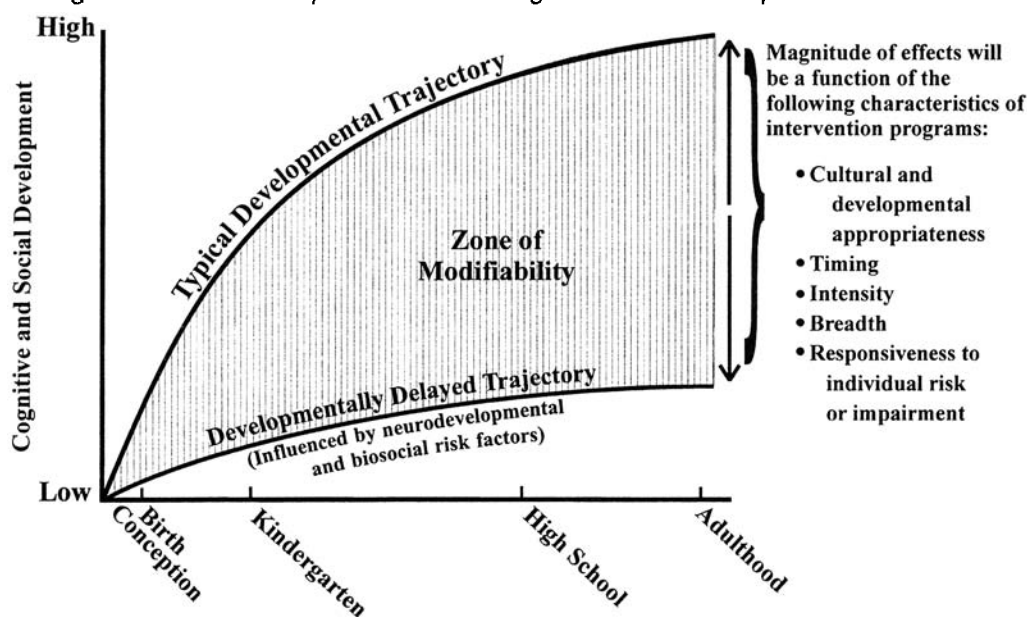
Criteria for the Success of Early Intervention

The criteria for the success of early intervention must be understood within the context of who participates and what the goals are for the early intervention program. For children with disabilities participating in federally mandated, state-enacted early intervention programs, there is an individualized plan for the child and the family that specifies needs, intervention components, and anticipated developmental progress or outcomes. These plans are to be developed collaboratively by professionals and parents and updated at least annually. No formal reporting of children's progress or systematic review of this early intervention system has occurred. Criteria for success remain elusive. At the level of the child and family, success is defined by the expectations that the family and the early intervention practitioners hold for the child.

Concerning at-risk children, success is typically defined broadly in terms of more positive intellectual and social-emotional development relative to the expected outcomes in the absence of early intervention. This com-

Figure 1

Hypothetical Range of Reaction for Experience-Driven Cognitive Neurodevelopment



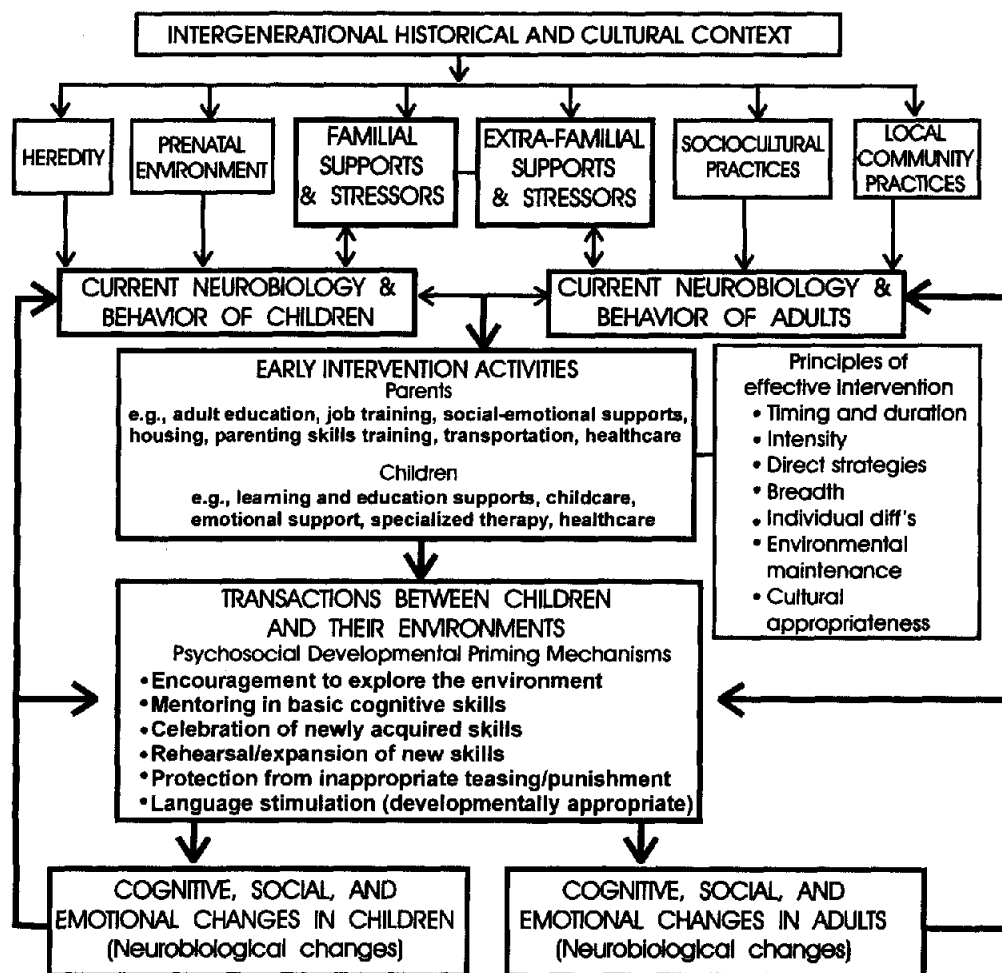
parative framework is vital to understanding the success or failure of early intervention. A widespread hope for early intervention is that children could be placed on a normative developmental trajectory and thus continue to show optimal development after early intervention ends. In this view, early intervention functions as an inoculation. In reality, children's development depends on both early and subsequent opportunities and experiences, as elaborated in the conceptual framework described below and illustrated in Figure 2.

Biosocial Developmental Contextualism: A Conceptual Framework for Early Intervention

Early intervention programs are typically ambitious in their goals, potentially broad in the array of services and supports they provide, and designed to be responsive to the needs of individual children and families. Such

programs defy simple characterization and are difficult to compare with one another. Moreover, early interventionists have yet to adopt a common language to describe intervention components. General phrases such as "comprehensive, coordinated, and community-based," "individualized," "culturally sensitive," and "family empowerment" are widely used and reflect an ideological basis for early intervention programs rather than a specific action plan. Such characterizations of programs do not provide an operational description of what programs actually do or how resources are allocated. Furthermore, program descriptions frequently fail to make explicit the means by which services and supports are thought to potentially change participants and to improve their quality of life. That is, the value of the services is presumed to be obvious (such as providing parenting education or early childhood education), and the specific mediating processes

Figure 2
Schematic Portrayal of Biosocial Developmental Contextualism Applied to Early Intervention



Note. diff's = differences.

by which these services might contribute to improved functioning of the family and the development of children frequently are unspecified and unmonitored.

In this section, we present a general conceptual framework for clarifying the goals, components, and developmental outcomes of early intervention programs. This framework is an intergenerational one that emphasizes both child and parent development. Figure 2 depicts salient sources of influence on the cognitive, social, and emotional development of children and their primary caregivers and specifies broad categories of intervention services. Within this framework, the current biological and behavioral status of children and adults reflects the cumulative effects of their personal histories. These influences include developmental genetics, the prenatal environment, pervasive sociocultural norms and practices, and special characteristics and resources of local communities. In addition, each family and child has particular supports and stressors from within and without the family that affect the quality and quantity of behavioral transactions among members; it is these transactions that are the primary mode of learning for young children.

At the start of an early intervention program, information is typically collected to understand the child and family within a larger social ecology. An individualized assessment of the child identifies particular risk conditions, disabilities, or both, and an evaluation of the family helps to contextualize decisions about intervention strategies, so that the early intervention builds on family beliefs, values, and routines in ways that complement community norms and practices.

Next, this framework illustrates that a range of resources and activities may be used to promote changes in children, parents, and the family's environment. Early intervention supports may be focused on (a) the family as a unit (e.g., adequacy of income, housing, and healthy lifestyles); (b) parents or primary caregivers (e.g., adult education, job training, family management skills); and (c) the child (e.g., early childhood education and specific neurodevelopmental therapies). These resources and supports may be provided directly by an early intervention program, through referrals to other services, and by strengthening natural support systems.

For an individual family, the decisions about allocating programmatic resources and activities frequently are made after a needs-assessment process. Almost all early intervention programs have developed some form of case management or care coordination—that is, a way to establish a trusting and continuous relationship between professionals or program staff and the family, to facilitate active family participation, to collect additional information over time, and to modify the family's service plan.

Within this general conceptual framework, changes in child and family developmental status are mediated by specific *psychosocial developmental priming mechanisms* (described below). That is, the early intervention supports and services are hypothesized to have their effect by altering the experiences and behavior of individual children and family members. Social transactions,

both within and without the family, and their cognitive mediation are construed as the primary mechanisms of developmental change.

Changes in very young children's cognitive, social, and emotional development are, of course, interrelated and neurobiologically mediated. Important developmental neurobiological mediators currently hypothesized to be implicated in early experience include neurotransmitter changes (such as in the serotonin and dopamine levels and the endorphin system), synaptic pruning as a function of experience (particularly use-dependent neural network development), and gene activation associated with experience (e.g., Shore, 1997). Approximately 60% of known genes are estimated to influence brain development, and their expression often depends on specific environmental inputs. This complex cascade, although only partially understood, has led developmental neuroscientists, developmental psychologists, and early interventionists to reframe the overly simplistic nature versus nurture debate. In a consensus report integrating the latest neuroscience and early intervention findings (Shore, 1997), a powerful single conclusion emerged:

All of this evidence—and a great deal more that is beyond the scope of this report—leads to a single conclusion: how humans develop and learn depends critically and continually on the interplay between nature (an individual's genetic endowment) and nurture (the nutrition, surroundings, care, stimulation, and teaching that are provided or withheld). The roles of nature and nurture in determining intelligence and emotional resilience should not be weighted quantitatively; genetic and environmental factors have a more dynamic, qualitative interplay that cannot be reduced to a simple equation. Both factors are crucial. New knowledge about brain function should end the "nature or nurture" debate once and for all. (pp. 26–27)

In Figure 2, the provision of early intervention activities includes monitoring the participation and progress of participants and adapting and modifying interventions as needed. The degree to which early intervention programs systematically document this process and associated neurodevelopmental and behavioral changes in children and adults will determine the generation of a cumulative knowledge base about a program's operation and impact on families. This knowledge base can help guide a program's future activities and resource allocation as well as inform others engaged in early intervention with similar types of children and families in comparable community and cultural contexts.

Psychosocial Developmental Priming Mechanisms

We abstracted from the literature six psychosocial mechanisms repeatedly associated with positive cognitive, social, and emotional outcomes of children (S. L. Ramey & Ramey, 1992). We hypothesize that these mechanisms are appropriate to adults as well, although more research is needed to substantiate this point of view. We have labeled these *developmental priming mechanisms* to emphasize both their potential role in altering the course of human development and the fact that they help individuals

become primed or ready for subsequent developmental opportunities.

The six developmental priming mechanisms, identified in Figure 2, are (a) encouragement to explore the environment, (b) mentoring in basic cognitive and social skills, (c) celebrating new skills, (d) rehearsing and expanding new skills, (e) protection from inappropriate punishment or ridicule for developmental advances, and (f) stimulation in language and symbolic communication.

These priming mechanisms are hypothesized to be critical to normal development and must be present in children's everyday lives on a frequent, predictable basis. For children with specific disabilities, assistive technology may be vital to ensure the presence of these priming mechanisms. We do not presume that these six mechanisms are exhaustive; rather, they represent ones with strong empirical support.

On the basis of our years of research in early experience and early intervention program development, we view a conceptual framework as essential to make the myriad relevant factors coherent and practically manageable. We offer biosocial developmental contextualism as an inductively derived conceptual framework to stimulate discussion, elaboration, and refinement of early intervention programs and their evaluation.

Early Intervention Findings

Does Early Intervention Alter Development?

During the past four decades, a large and remarkably consistent research literature has been developed concerning the efficacy of early intervention for at-risk children. Reviews of this literature include the edited volume by Guralnick (1997) and the work of White and Boyce (1993), Farran (1990), Haskins (1989), Karweit (1989), the Carnegie Task Force on Meeting the Needs of Young Children report (1994), and Bryant and Maxwell (1997). There are remarkable consistencies in the major findings derived from early interventions that are characterized by the provision of intensive, high-quality services and the use of rigorous research designs with adequate controls. Much more has been reported about the effects of these programs on children's development than on parental development, and much more has been reported on cognitive development than on social development. Thus, this review will concentrate on children's cognitive development, emphasize replicated findings, and note other findings in that context. Furthermore, because of likely biases associated with nonexperimental designs, only studies with random assignment to groups are mentioned, except as noted. Finally, several large-scale two-generation early intervention programs, which are multisite and randomized in nature, are currently underway and should be reported soon, including the Comprehensive Child Development Program and the recently launched Early Head Start Program. The research findings about early intervention derive from prospective randomized trials targeted for children at risk for developmental delay, mental retardation, poor school achieve-

ment, or all of these. The evidence accumulated over the past 25 years indicates that early intervention programs can produce modest to large effects (effect sizes of 0.2 to over 1 standard deviation) on children's cognitive and social development. Larger effect sizes have been associated with improved performance later in school, particularly when the schools are of good quality (e.g., Campbell & Ramey, 1994, 1995; Lazar, Darlington, Murray, Royce, & Snipper, 1982).

Variation exists in the degree and extensiveness of effects as well as in their duration. Presented below are six principles derived from the literature by S. L. Ramey and Ramey (1992), which are based on studies of children from economically impoverished families, children with biological risk factors, children with combined psychosocial and biological risks, and children with developmental disabilities diagnosed in infancy. Evidence supporting these principles is selectively cited, and these principles are incorporated into the conceptual framework presented in Figure 2.

Principle 1: Principle of developmental timing.

Generally, interventions that begin earlier in development and continue longer afford greater benefits to the participants than do those that begin later and do not last as long.

A consideration of the entire literature (see comprehensive reviews cited above) supports the notion that programs that enroll children at younger ages and continue longer produce the greatest benefits. Five major studies demonstrating some of the largest effects of early intervention on children's early cognitive and social development—namely, the Abecedarian Project (e.g., Campbell & Ramey, 1995), the Brookline Early Education Project (Hauser-Cram, Pierson, Walker, & Tivnan, 1991), the Milwaukee Project (Garber, 1988), Project CARE (Wasik, Ramey, Bryant, & Sparling, 1990), and The Infant Health and Development Program (1990; C. T. Ramey et al., 1992)—all enrolled children during infancy. A confound in the empirical literature is that programs that provide early and multiyear interventions also tend to be intensive (see Principle 2 below). To date, there are no compelling data to support the notion of an absolute critical period such that educational intervention provided after a certain age cannot be beneficial; rather, this is a principle of relative timing effects.

Principle 2: Principle of program intensity.

Programs that are more intensive (indexed by variables such as number of home visits per week, number of hours per day, days per week, and weeks per year) produce larger positive effects than do less intensive interventions. Furthermore, children and parents who participate the most actively and regularly are the ones who show the greatest developmental progress.

Two landmark studies demonstrating benefits of early intervention began when children were three or four years old: the Perry Preschool Project (Weikart et al., 1978) and the Early Training Project (Gray, Ramsey, & Klaus, 1982). Both were of high program intensity. Similarly, the experimental programs named above (see Prin-

ciple 1) all provided highly intensive services and supports to children and their families. In contrast, there are numerous examples of early interventions that did not significantly change children's intellectual, social, or later academic performance. A characteristic of these unsuccessful interventions is that they were not intensive. For example, none of the 16 randomized trials of early interventions for children with developmental disabilities, conducted by the Utah State Early Intervention Research Institute (White, 1991), provided full-day programs or multiple home visits per week. Not surprisingly, no significant effects on children's competencies were detected in these programs. Similarly, a relatively brief prenatal and postnatal program for urban teen mothers was not sufficiently intensive to alter children's cognitive performance or social development during the preschool years (Brooks-Gunn & Furstenberg, 1987). In addition, Scarr and McCartney (1988) provided a parent-oriented home-visiting intervention for one time per week to economically impoverished families in Bermuda. They, like Madden, Levenstein, and Levenstein (1976) in a subsequent randomized trial, also failed to detect any positive cognitive or social effects.

There are two-generation programs that provide experimental evidence that program intensity matters. One was an early intervention home-visit program (Powell & Grantham-McGregor, 1989) that detected significant cognitive benefits from a program with an intensity level of three visits per week, although not from a program with less frequent home visits. Another was the Brookline Early Education Project (Hauser-Cram et al., 1991) that reported that only the project's most intensive two-generation service model was sufficient to produce significant benefits for children at risk for school difficulties (i.e., the children from low-education families), whereas the lowest and intermediate intensity interventions had no measurable effects on cognitive or social outcomes.

Only one study so far has addressed the topic of program intensity at the level of the individual child—namely, The Infant Health and Development Program (1990). C. T. Ramey et al. (1992) reported that the amount of intervention each child and family received, on the basis of daily monitoring of program participation over the first three years of life, had a strong, positive relationship to the child's intellectual and social development at 36 months. When expressed in terms of prevention of mental retardation, the highest participation group had nearly a ninefold reduction in the proportion of low-birth weight children who were mentally retarded compared with the control group, which received high-quality pediatric follow-up services but not home visits or a center-based daily education program. Blair, Ramey, and Hardin (1995), in a year-to-year longitudinal analysis of this same study, revealed that children's yearly intellectual development was strongly linked to variations in yearly participation rates.

Principle 3: Principle of direct (vs. intermediary) provision of learning experiences. Children receiving interventions that provide direct educational

experiences show larger and more enduring benefits than do children in programs that rely on intermediary routes to change children's competencies (e.g., parent training only).

Successful early interventions have been presented in many different forms, including those that are center-based with trained staff who work directly with children, those that are home-based and seek to enhance children's everyday learning opportunities, and those that combine these components. Interventions may be categorized in terms of reliance on direct intervention contact with the children versus an indirect approach in which the primary caregivers (usually parents) learn new ways to enhance the children's development and ideally become more effective in their transactions with the children. Empirical findings regarding the differential effects of these strategies are clear: Indirect or intermediary techniques have been less powerful than direct approaches to (and often ineffective in) enhancing children's intellectual and social experiences (e.g., Casto & Lewis, 1984; Madden et al., 1976; Scarr & McCartney, 1988; Wasik et al., 1990).

Wasik et al. (1990) conducted the first experimental test of the value of direct versus intermediary forms of early intervention. On the basis of a randomized controlled trial with economically disadvantaged, high-risk children from birth through five years of age, they found that combining daily center-based intervention with weekly parent-oriented home visits resulted in significant cognitive gains for the children, whereas a weekly home-visit (intermediary) program sustained over five years had no measurable benefits on children's cognitive or social performance, parent attitudes or behavior, or the quality of the home environment. Findings such as these warrant serious consideration and challenge the basis for the popularity of interventions that rely on infrequent home visits only—currently the most widely used form of early intervention in the United States (Roberts et al., 1991). The recognition and celebration of parents and other family members as natural providers of young children's early learning experiences is profoundly important and should be encouraged. The practical question for the field of early intervention, however, is whether parent education and general family support programs can be justified if they do not produce child benefits. The findings of Powell and Grantham-McGregor (1989), cited in Principle 2, are promising and support the need for more parametric studies of early intervention alternatives, particularly for studies on varied intervention intensity and duration.

Principle 4: Principle of program breadth and flexibility. Interventions that provide more comprehensive services and use multiple routes to enhance children's development generally have larger effects than do interventions that are narrower in focus.

The intervention studies that have produced relatively large early effects, such as the Abecedarian Project, the Brookline Early Education Project, Project CARE, the Milwaukee Project, The Infant Health and Development Program, and the Mobil Unit for Child Health, all

adopted a broad, multipronged approach. They provided ongoing health and social services, transportation, practical assistance with meeting urgent family needs, individualized neurodevelopmental therapies as needed, and parent services and training, as well as a strong educational program for the children. For example, in the Mobil Unit Project, Gutelius, Kirsch, MacDonald, Brooks, and McErlean (1977) found significant cognitive effects in a three-year program that combined prenatal counseling, well-baby care, infant stimulation activities with an emphasis on language, educational toys, and family education concerning child development and family problems. As Schorr and Schorr (1988) observed,

Programs that are successful in reaching and helping the most disadvantaged children and families typically offer a broad spectrum of services. They recognize that social and emotional support and concrete help (with food, housing, income, employment—or anything else that seems to the family to be an insurmountable obstacle) may have to be provided before a family can make use of other interventions, from antibiotics to advice on parenting. (p. 257)

Principle 5: Principle of individual differences in program benefits. Some children show greater benefits from participation in early interventions than do other children. Thus far, these individual differences appear to be related to aspects of the children's initial risk condition.

The idea that individuals respond differently to the same program and its corollary, that different programs may be needed to produce similar outcomes in individuals with different risk factors, has prevailed in the clinical and educational literatures—alternatively phrased as “the problem of the match” (Hunt, 1961) or “person $\times$ environment interaction.” Only recently, however, has this been explored systematically in the early intervention field. Examples of new findings are described here.

In providing broad-based early intervention for premature, low-birth weight infants, The Infant Health and Development Program (1990) reported that children at greater biological risk (indexed by very low birth weight) did not benefit as much from the program as did less impaired children—even though both groups showed significant gains. 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 (1993) found an aptitude by treatment effect in a randomized design comparing Feuerstein's (1979) “mediated learning” techniques with more traditional “direct instruction.” Contrary to conventional wisdom, relatively higher performing students (as measured on a pretest battery of cognitive, language, and motor tests) gained more from direct instruction, whereas lower performing students showed greater benefits from the mediated learning treatment.²

Olds and Henderson (1989) reported a positive parental outcome of fewer instances of child abuse and neglect for the highest risk group—mothers who are young, single, and poor. When these multirisk mothers received the study's most comprehensive treatment package (i.e., prenatal and postnatal home visits by a public health nurse), 4% had official reports of maltreatment compared with 19% of multirisk mothers who did not receive the entire complement of services (Barnett, 1997). Finally, an analysis of findings from the Abecedarian Project (Martin, Ramey, & Ramey, 1990) revealed that the children who showed the greatest relative gains compared with controls were those whose mothers were the most intellectually limited, having IQ scores below 70. In fact, all experimental children whose mothers were mentally retarded performed at least 20 points higher than control-group participants and averaged 32 points higher than did their own mothers (Landesman & Ramey, 1989). These dramatic findings are directly comparable to the large cognitive benefits reported in the Milwaukee Project, which enrolled only economically disadvantaged mothers with IQs below 75 (Garber, 1988). Very recently, these findings have been substantiated by using maternal education as an index of need in The Infant Health and Development Program (Blair et al., 1995). In this program, children of mothers who had less than a high-school education benefited the most from intensive early intervention.

Principle 6: Principle of ecological dominion and environmental maintenance of development. Over time, the initial positive effects of early interventions will diminish to the extent that there are not adequate environmental supports to maintain children's positive attitudes and behavior and to encourage continued learning related to school.

For several programs, long-lasting and substantial positive effects on school achievement and reductions in grade retention and special-education placement have been detected (e.g., Campbell & Ramey, 1995; Lazar et al., 1982; Schweinhart & Weikart, 1993). In some studies, but not all (e.g., Garber, 1988), the long-term effects of early educational intervention on IQ scores are lessened over time. Two important issues are relevant. First, as indicated in Figure 1, it is not sufficient for children merely to maintain the specific advantages from effective early intervention detected at the point that early intervention was terminated. Rather, children must continue to develop at normative or near normative rates in multiple domains if they are to score subsequently at comparable levels on IQ or academic achievement tests and to continue to succeed in school. No influential developmental theory of which we are aware is premised on the assumption that positive early learning experiences are sufficient

² “Mediated” and “direct instruction” are technical terms within Feuerstein's (1979) classification system that refer to methods of teaching and should not be confused with the earlier discussion, which used these terms to refer to direct versus parent-mediated modes of early intervention.

by themselves to ensure that children will perform well throughout their lives. Poor school environments, suboptimal health, a seriously dysfunctional home environment, economic depression, and many other contextual conditions are known to influence the behavior of children and, indeed, adults, at all ages. Thus, longitudinal inquiry about the long-term effects of early intervention must take into consideration children's environments and experiences both during and after early intervention.

Only one randomized study to date has continued early intervention into the elementary school years to evaluate the importance of additional supports during the transition to school. The findings are noteworthy: At eight years of age, children who had received continuous intervention for the first eight years of life performed the best of any group in reading and mathematics at age eight, followed next by those who received early intervention for the first five years of life, followed next by those who received the elementary school intervention for three years—when all groups were compared with controls (Horacek, Ramey, Campbell, Hoffman, & Fletcher, 1987). Reynolds (1994) recently reported a comparable finding from a nonrandomized design involving over 1,100 former Head Start children in Chicago. Thus, the continuation of systematic intervention into the public school years is likely to be needed and to vary as a function of the overall quality of the developmental environment in which the child resides. Environmental quality includes but is not limited to family, peer, and school resources with respect to developmental priming mechanisms.

Contemporary Issues

There are many program development, scientific, and public policy issues of contemporary importance. We comment briefly on five issues that we judge to be crucial to continued scientific and cost-effective progress in the field of early intervention.

Timing and Content Variations in Early Intervention Programs

The question of the efficacy of early intervention has now been answered in the affirmative in many single-site studies and replicated in multisite randomized trials. Yes, early intervention can improve the course of early human development during its application. This answer begs for systematic, theoretically explicit comparisons of various intervention approaches. Of particular importance are variations in intervention content and intensity during the first three years of life. It is during the first three years that intervention efforts generally must change from a preventive to a remedial focus (see Figure 1). We must better understand the relative effectiveness of different and differently timed approaches. Answers to these issues have obvious implications for the cost-effectiveness of early intervention.

Differential Risk and Differential Response to Early Interventions

The selection criteria for early intervention participants are currently relatively crude. In Head Start, for example, the sole eligibility criterion is family income below the yearly adjusted federal poverty line when the family applies. For children with disabilities, eligibility is typically determined by a score below a cutpoint on one of a wide variety of cognitive or adaptive behavior tests. We have argued elsewhere (Landesman & Ramey, 1989) that such procedures are likely to lead to overidentification of children for early intervention services, thus driving up public costs by providing unnecessary but desirable services to some children and families. We now know that there are important and systematic variations in developmental risks and outcomes that are tied to different types of families who are below the poverty line (C. T. Ramey, Ramey, & Lanzi, in press). Therefore, better targeting of early intervention services deserves closer scrutiny. Similarly, some children and families respond better to particular early interventions than do others. This knowledge needs to be expanded and incorporated systematically into policy decisions about programs.

Lasting Effects (or Not) and Mediating Mechanisms

First, contrary to opinion as expressed recently in *The Bell Curve* (Herrnstein & Murray, 1994), relatively few early intervention programs have received long-term follow-up. The knowledge base of long-term effects needs to be expanded by high-quality follow-up of experimentally adequate studies.

Second, the issue of lasting effects in the context of early intervention must be understood as maintenance of a rate of acquisition in particular domains of functioning after intervention has ceased as opposed to retention of previously learned material. To illustrate, preschool programs may provide experiences relevant to basic quantitative concepts such as size or number, but these must be understood as prerequisites to the formal operations required for addition or multiplication and these, in turn, as prerequisites for the mastery of algebra or calculus. Without postulation of specific mediating or carrier mechanisms, it is theoretically unwarranted to expect even an excellent preschool program that had a partial emphasis on mathematical fundamentals to result in relative superiority in, say, ninth-grade algebra. That is not to say that such continuities are impossible but simply that there must be some bridging or mediating mechanism to provide the cognitive scaffolding for such a relationship. What are plausible mediating mechanisms for such established long-term positive effects such as higher cognitive performance, better school achievement, and reduced grade retention and special-education placement?

We discern four major types of likely long-term mediating mechanisms: (a) an increase in a child's intellectual skills that allows the child to gain more from later experiences (e.g., through increased understanding of developmentally appropriate books); (b) a motivational

change in the child, such that the child seeks out or creates advantageous learning experiences; (c) an enhanced knowledge base that results in greater environmental opportunities provided by others (e.g., accelerated school programs, more positive peer groups); and (d) access to more supportive environments, particularly those with more facilitative teachers, parents, and peers. Collectively, these postintervention mechanisms may serve to promote continued development through the same priming mechanisms that determine the effectiveness of the early intervention itself. These mechanisms are not mutually exclusive, and their accompanying neurobiological substrates warrant systematic inquiry in studies of the long-term benefits of early intervention.

The Issue of Cultural Congruence

To achieve desired outcomes, interventions provided for children and families need to recognize and build on cultural beliefs, traditions, and practices. To the extent that interventions are perceived as culturally relevant and welcomed, they are more likely to be valued, used, and incorporated into participants' everyday lives. More attention to this important topic is clearly needed, particularly as the United States continues to become more culturally diverse. (For excellent detailed discussions on these issues, see Slaughter-Defoe, Nakagawa, Takanishi, and Johnson, 1990, and, Spencer, 1990.)

The Relation of Developmental Science and Public Policy Formulation

Biosocial developmental contextualism is as germane to the public policy analysis of early intervention as to the development of individual children and their families. Specifically, this framework predicts that early interventions that do not directly change children's daily social transactions—particularly in terms of the presence of developmental priming mechanisms—will not produce measurable benefits in children's development. Furthermore, this framework indicates that for early intervention programs to be evaluated adequately, there must be prospective documentation of the actual services and supports each child and family receives. We cannot be content with simplistic analyses that compare an undocumented, intended-to-treat experimental group with a control group whose developmental experiences also are undocumented.

The demands of scientific rigor must be combined with the ever-changing and multiple constituencies that shape public policy development and debate. Historically, science and public policy have been uneasy companions because of quite different traditions of evidence. Nevertheless, a usable knowledge base currently exists, and the way to expand it is clear. The primary issues for early intervention now are ones of the political will to aid vulnerable children, the appropriate scale of resources needed to provide potentially effective interventions, and commitment to conducting rigorous research to move the field of early intervention forward.

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