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Why Early Intervention Works

A Systems Perspective

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A systems perspective is put forward designed to place the many diverse conceptual and practice approaches and accomplishments in the early intervention field within a common framework. Complex reciprocal patterns of influence are described emphasizing risk and protective factors operating at 3 levels: child social and cognitive competence, family patterns of interaction, and family resources. It is argued that this framework can provide an understanding with respect to why early intervention works when it does as well as establish a new assessment and intervention approach firmly grounded in developmental science. **Key words:** *developmental science, early intervention, systems perspective*

CONCEPTUALLY AND EMPIRICALLY grounded in developmental models suggesting the importance of early experience and the greater malleability of early development, a system of early intervention (EI) services and supports for vulnerable children and their families has become firmly established in the United States and in many other countries as well. The legislative history that culminated in the current system in the United States consisted of incremental efforts that eventually encompassed specific groups of children at risk for developmental delays as well as virtually all young children with established disabilities (Gilliam, 2008; Meisels & Shonkoff, 2000; Trohanis, 2008; Wise & Richmond, 2008). A major challenge for this emerging EI system was to accommodate to the remarkably diverse characteristics of the participating children and their families.

Indeed, the complexity of the sources of children's biological risk and disability was eclipsed only by the complexity of the developmental patterns that resulted. Moreover, the diversity of the families themselves, especially those with insufficient personal and material resources to optimally support their child's development, added a dimension of environmental risk that further challenged the EI system.

For children with established disabilities, diagnostic categories including developmental delay, cerebral palsy, autism spectrum disorder, or specific language impairment were further refined on the basis of subgroups sharing common characteristics (eg, autism disorder) or on the basis of etiology (eg, Down syndrome, size and location of lesion). A similar, though less well developed, categorization based on the number and type of environmental or biological risk factors also emerged (Burchinal, Roberts, Hooper, & Zeisel, 2000; Liaw & Brooks-Gunn, 1994; Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987). Together, these categorizations provided an important initial framework that facilitated the design, implementation, and evaluation of EI programs and their effectiveness. Indeed, decades of empirical work that served to support existing legislation in the United States indicated that, despite wide ranges of responsiveness among individual children, EI can be highly effective yielding effect sizes

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averaging 0.50 to 0.75 SDs (Guralnick, 1998). More recent work, often using well-designed randomized clinical trials, continues to provide support for the benefits of EI including children at biological and environmental risk (Landry, Smith, Swank, & Guttentag, 2008; Love et al., 2005; Ludwig & Phillips, 2008), children with autism (Dawson et al., 2010; Howlin, Magiati, & Charman, 2009), and children with heterogeneous developmental delays including those with Down syndrome (Guralnick, 2005a; Thomaidis, Kaderoglou, Stefou, Damianou, & Bakoula, 2000).

As might be expected, close examination of the EI protocols for these and numerous other studies reveals an unusual level of diversity with respect to conceptual frameworks, goals, and intervention approaches. To some extent, these wide-ranging differences reflect the special concerns of diverse subgroups of vulnerable children and their families, many presenting with unique sets of risks and developmental patterns associated with specific developmental periods. Moreover, new approaches to EI have emerged regularly over the years, resulting from translational efforts based on new conceptual frameworks and empirical findings.

At a different level, general systems guidelines are available that have provided some level of coherence and consistency to these diverse EI practices, including many of the essential structural features emphasized in current legislation for EI (Bruder, 2010; Guralnick & Conlon, 2007; Hauser-Cram & Warfield, 2009). Systems features such as adopting a family-centered approach, requiring individualized interventions, and ensuring coordination of services supported by a research base, in addition to generally agreed-upon values and principles, have now achieved international consensus (Guralnick, 2008). Nevertheless, an observer attempting to understand the field can easily become overwhelmed with the myriad of intervention details and conceptual frameworks encountered, especially in view of the many disciplines and service agencies involved in EI. In fact, it is quite possible that the manner of growth of the EI

field and resulting diversity made it extremely difficult to detect shared themes or develop an overarching vision capable of organizing and analyzing the many diverse approaches and accomplishments of EI within a common framework. In this article, I argue that it is now possible to achieve such a framework in the form of a systems approach that is firmly grounded in developmental science. It is further suggested that this systems framework can provide an understanding with respect to why EI works as well as establish directions to improve the effectiveness of EI practices.

SYSTEMS PERSPECTIVE

A systems orientation has been central to numerous models of child development (Lerner, Theokas, & Bobek, 2005; Sameroff, 2010). Fundamental to these models is a recognition of the hierarchical organization of development and an effort to understand the mechanisms through which components of the system interact with one another to form subsystems that combine and recombine to create an ever-increasing complex pattern of developmental growth. Defining the processes through which biological mechanisms, especially those based on genetic factors, interact with environmental events to influence development has also been a core concept of these systems models (Hanson & Gottesman, 2007; Meaney, 2010). The transactional model (Sameroff, 2009), the developmental biological systems view (Gottlieb, Wahlstein, & Lickliter, 1998), the organizational perspective (Cicchetti & Tucker, 1994; Rutter & Sroufe, 2000), developmental systems theory (Ford & Lerner, 1992), ecological theory (Bronfenbrenner, 2001; Bronfenbrenner & Morris, 1998), the parenting process model (Belsky, 1984), and the dynamic systems theory (Thelen & Smith, 1998) are some of the key systems models in this tradition. These models have all contributed to efforts to understand atypical child development, the most influential of which is the developmental psychopathology approach (Cicchetti, 2006; Lewis, 2000).

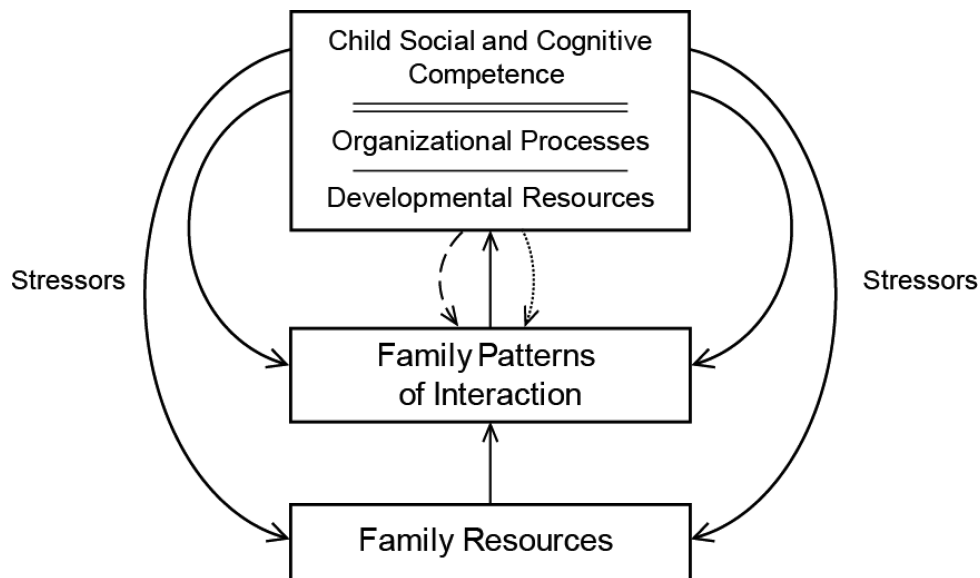


Figure 1. The 3 levels of the developmental systems approach illustrating their interrelationships and reciprocal influences including the effects of stressors on the system.

The developmental systems approach (DSA) (Guralnick, 2005b) discussed in this article is entirely compatible with these systems perspectives. However, a distinguishing feature of the DSA is its goal to understand the developmental mechanisms that are involved in promoting a child's development in the context of EI for vulnerable children and their families. As will be seen, for this to be accomplished, an integration of the developmental science of normative development, the developmental focus on risk and disability, and intervention science is essential.

By way of overview, the DSA involves attention to 3 interrelated levels that reflect this integration (see Figure 1). First, attention is required at the level of child development, complete with an understanding of how children utilize their growing developmental resources and organizational processes to expand their social and cognitive competence throughout early childhood. Second, the DSA requires the identification of environmental influences that support children's emerging social and cognitive competence as governed by a family's pattern of interactions involving

the child. This pattern of interactions depends on many factors including adjustments by families to accommodate to the unique constellation of their child's developmental and behavioral characteristics so necessary to support optimal child development (represented by the dotted arrow from the level of child development to the level of family patterns of interaction). The DSA also recognizes the potential moderating influence of each child's unique characteristics on these family patterns (represented by the dashed line in Figure 1). Clearly, similar family patterns of interaction can have diverse effects on children with different child characteristics. Third, the DSA requires an identification of those family resources that, in many respects, determine and are available to support optimal family patterns of interaction.

From the perspective of EI programs, as indicated in Figure 1 by the solid arrows flowing from the level of child development, an essential requirement in developing EI programs within the DSA framework is to conduct an analysis of those family patterns of interaction and family resources that may be unusually stressed or perturbed by the

presence of a child at biological risk or one with a disability. That is, for a variety of reasons discussed later, many of the adjustments by families to their child's characteristics essential to maintain optimal development (as represented by the dotted arrow) may not occur or may be insufficient (as represented by the solid arrows). As a consequence, stressors created by children at biological risk or with a disability create increasingly adverse effects (risks) on family patterns of interaction over time and, ultimately, children's cognitive and social competence. Moreover, the DSA also accounts for those circumstances in which insufficient family resources exist well before a child is born. In this instance, limited family resources may directly adversely influence family patterns of interaction (environmental risk) and, as a consequence, also affect children's social and cognitive competence. Each of the 3 levels depicted in Figure 1, the many risk and protective factors associated with each level, and the interrelationships and reciprocal influences within and across levels are discussed later to provide a basis for understanding the mechanisms through which EI operates to generate its effects. Taken together, within the framework of the DSA, it is proposed that the central task of EI is to establish or restore family patterns of interaction to as optimal a level as possible.

LEVEL OF CHILD DEVELOPMENT

Children's development is conceptualized within the DSA framework in terms of trajectories of ever-increasing social and cognitive competence over time. Competence in these 2 interrelated areas becomes manifest when children attempt to carry out specific goals. The nature and sophistication of these goals change dramatically throughout early childhood but the organizing power of goal-directed behaviors is apparent even in infancy (Woodward, 2009). As conceptualized within the DSA, social and cognitive competence is dependent on an array of developmental resources and organizational processes (see Figure 2) that develop at a rapid

pace throughout the early childhood period. Developmental resources are domain-specific abilities, skills, and knowledge that have been well defined and effectively measured. These include conventionally organized domains of cognition, language, motor, social-emotional, and sensory-perceptual development. Developmental studies of young children have revealed the details of how children call upon these developmental resources to support their emerging competencies during goal-oriented activities. Indeed, a major contribution of the field of child development in recent decades has been to identify the array of associations that exist between these domains (developmental resources) and children's competence (McCartney & Phillips, 2006). Vocabulary growth, increases in syntactic complexity, and the ability to understand the intentions of others and related mental states provide just a glimpse into some of the important language and cognitive resources that become available to young children over time. The carefully documented and described developmental trajectories of motor, social-emotional, and sensory-perceptual domains provide a correspondingly rich array of developmental resources. Although capable of being measured separately, these developmental resources are clearly interdependent. As suggested by systems models noted earlier, these resources combine and recombine both within and between domains, becoming continuously integrated into a hierarchy of more complex forms in support of children's social and cognitive competence.

Organizational processes

As important as these developmental resources are to children's developing social and cognitive competence, successful goal-directed behavior requires the involvement of processes operating at a different level. Specifically, and as further conceptualized in the DSA, these developmental resources are harnessed and organized by a set of organizational processes during goal attainment activities. The following 5 organizational

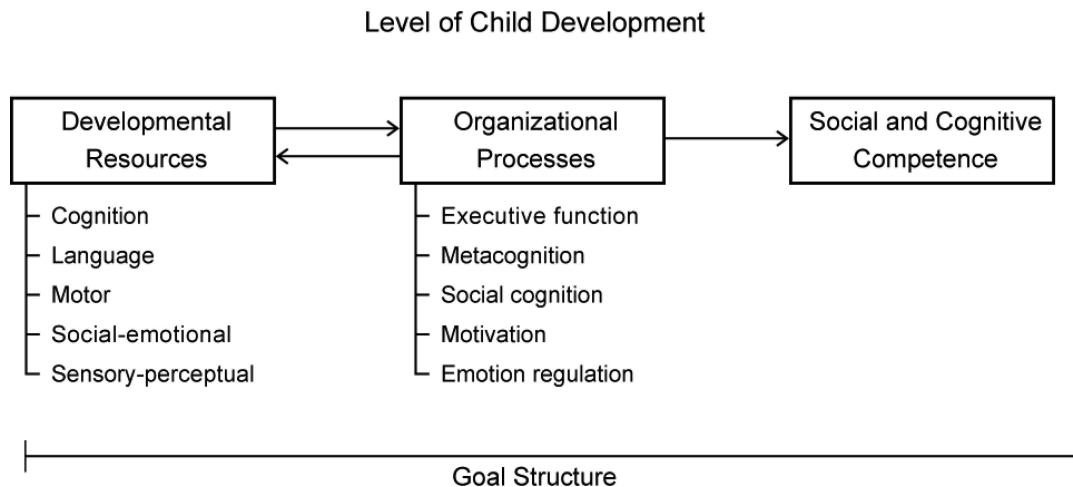


Figure 2. Model illustrating how organizational processes and developmental resources, framed by a goal structure, constitute the basis for a child's social and cognitive competence.

processes have been identified as central contributors to children's competence: (1) executive function (emphasizing higher-order cognitive processes that serve to organize developmental resources and other organizational processes to maintain goal orientation) (see Banich, 2009, as well as Anderson, 2002, and Welsh, Friedman, & Spieker, 2005); (2) metacognition (emphasizing awareness and knowledge of task relevant problem-solving strategies) (see Kuhn, 2000, and Pintrich, 2000); (3) social cognition (emphasizing components of social tasks including encoding social information, interpreting that information, and generating prosocial responses) (see Beauchamp & Anderson, 2010; Crick & Dodge, 1994; Lemerise & Arsenio, 2000; Rose-Krasnor, 1997; Yager & Ehmann, 2006); (4) motivation (emphasizing mastery motivation and reward systems relevant to goal selection and task persistence) (see Morgan, MacTurk, & Hrnčir, 1995); and (5) emotion regulation (emphasizing the effortful process involving appraisals of emotional experiences and strategy generation to maintain goal orientation) (see Eisenberg & Spinrad, 2004, and Rothbart & Rueda, 2005). These complex organizational processes can also be measured effectively, but the task is admittedly far more difficult. Nonetheless, overall assessments of

each organizational process are available as are measures of specific components that constitute each process (eg, attentional shifting and inhibition for executive function; encoding and availability of a repertoire of prosocial responses for social cognition). Similar to developmental resources, organizational processes are characterized by interdependence and even sharing of components (eg, inhibition component being relevant to both executive function and emotion regulation) (Beer & Ochsner, 2006; Kaplan & Berman, 2010).

Points key to this brief summary of organizational processes are that these processes are engaged when children participate in goal-oriented activities, have developmental trajectories that can be measured reliably, and are highly interrelated with one another at many levels. Although it is beyond the scope of this article to provide details, as is the case for children's developmental resources, these processes are strongly associated with children's developing social and cognitive competence. It should also be noted that despite being conceptualized at the behavioral level, the systems features of the DSA have been influenced by and are entirely compatible with contemporary neurobiological systems models that emphasize functional connectivity, regional specialization, and interactions

among neural subsystems and circuits (Blair, 2002; Johnson, 2001; Yeates et al., 2007).

To be sure, each of the developmental resources and organizational processes displays wide individual differences. Indeed, inadequate growth or atypical patterns in a child's developmental resources or organizational processes can constitute risk factors that are capable of compromising the expected and predictable trajectory of children's social and cognitive competence. At the same time, other developmental resources and organizational processes can serve as protective factors, in the sense that they continue to promote children's developing competence even in the face of this adversity. Indeed, there are many pathways to goal attainment and competence at the level of child development (Cicchetti, 2006). As will be discussed, within the DSA, constructing profiles of children's developmental resources and organizational processes is an essential component of EI programs for vulnerable children. Such an assessment not only provides information with respect to a child's current developmental status but also serves to highlight areas of special concern that may require substantial adjustments in a family's pattern of interactions to optimize their child's development.

LEVEL OF FAMILY PATTERNS OF INTERACTION

The developmental science of normative development has reached a point in which environmental factors that influence the variable but yet generally predictable patterns of children's social and cognitive competence can be identified with reasonable confidence (eg, Bradley & Corwyn, 2004; Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). Indeed, for vulnerable children and their families, as elaborated upon later in this article, one contribution of the DSA has been to organize these well-established environmental factors based on the developmental science of normative development in the form of family patterns of interaction to cre-

ate a framework compatible with the goals of EI (Guralnick, 2005b). As indicated earlier, in instances in which specific family patterns of interaction appear to be less than optimal with respect to promoting a child's development, the ability to address those risk factors generated by stressors at the level of child development or due to already-existing limited family resources (environmental risk) comprehensively is seen as the key to effective EI practices.

Within the DSA, 3 types of family patterns of interaction that promote children's social and cognitive competence have been identified: (1) parent-child transactions, (2) family-orchestrated child experiences, and (3) health and safety provided by the family (see Figure 3). As noted briefly later, each of these family patterns of interaction and their components have well-documented associations with children's social and cognitive competence at the level of child development as well as with virtually all aspects of children's developmental resources and organizational processes. Indeed, establishing these between-level relationships and the details of their associations has been another of the important accomplishments of the developmental science of normative development in the past quarter century (McCartney & Phillips, 2006).

Parent-child transactions

As conceptualized within the DSA, parent-child transactions, the first component of family patterns of interaction, consist of a series of "relationship processes." These relationship processes are thought to gradually develop over time through frequent and extended sequences of successful and synchronous parent-child exchanges (see Feldman, 2007). In so doing, each participant begins to recognize his or her role in the relationship and, in a real sense, a shared psychological state emerges with clear expectations about each relationship process (Tomasello & Carpenter, 2007). Parents, of course, bring certain attitudes, skills, and abilities to these relationship processes

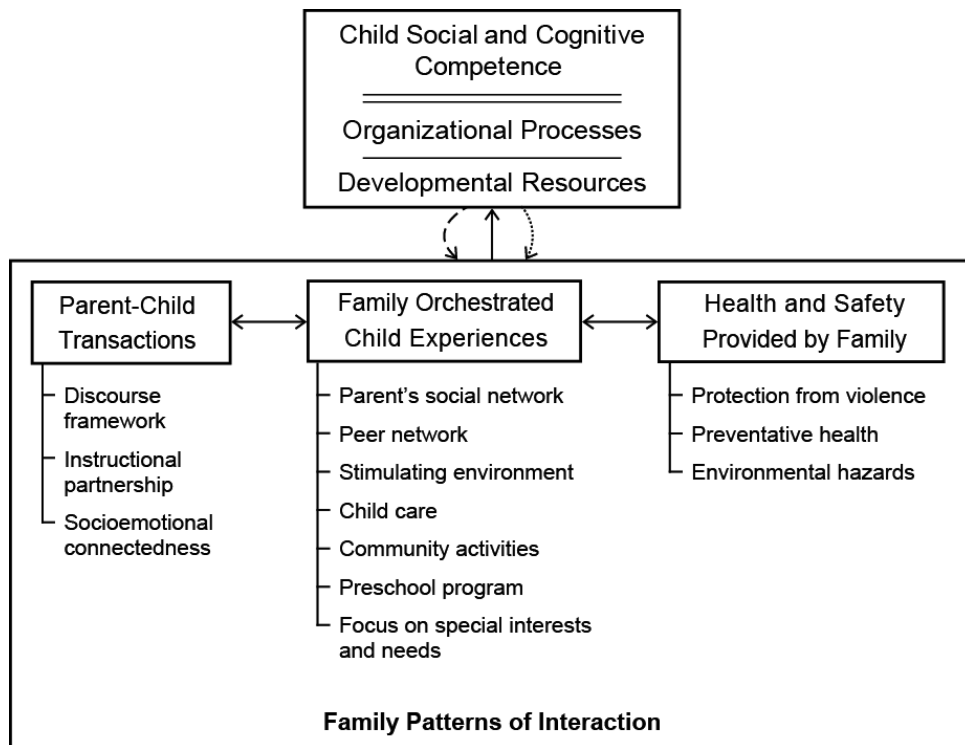


Figure 3. The developmental systems approach framework illustrating the influence of the 3 family patterns of interaction with their key components.

(Papoušek & Papoušek, 2002) and capitalize on children's eagerness to participate (Shonkoff & Phillips, 2000). Indeed, a substantial developmental literature exists with respect to the importance of parents' sensitivity and responsiveness to their child's behavior, the significance of positive affect in those adaptive interactions, and the need to be engaged with their child for sufficient periods of time so that the developmental value of relationships can be realized (Collins et al., 2000). These parent characteristics form the basis for the following 3 relationship processes proposed within the DSA as constituting the key components of parent-child transactions: (1) discourse framework, (2) instructional partnership, and (3) socioemotional connectedness. It is further suggested that it is these 3 relationship processes that give substance and meaning to parent-child transactions and constitute an essential structure that enables

these relationships to promote various dimensions of children's social and cognitive competence (see Figure 3).

A discourse framework represents that complex, constantly evolving social-communication process between parent and child, often occurring in the context of family routines (Fiese & Spagnola, 2007). It is through these frequent social exchanges that children seek and acquire information needed to satisfy their interests and support their goal-directed behavior. "Conversations" ranging from social referencing exchanges to extended discussions of the child's own and others' mental states are examples of this type of process that evolves over time (Adrian, Clemente, & Villanueva, 2007; Chouinard, 2007; Mundy & Sigman, 2006; Thompson, 2006). This discourse framework, with the often intense give-and-take series of exchanges, forms a relationship process

with expectations by both partners that parents will do everything possible to provide essential information when requested to do so. It is in this context that parents are able to gauge their child's knowledge and interests and introduce new knowledge through a process of conversational elaborations. The consequence is appropriate adjustments to their child's characteristics (emphasized by the dotted arrow from level of child development to the level of family patterns of interaction in Figures 1, 3, and 4) and the creation of circumstances that press for a child's further development of their social and cognitive competence.

This process is usually initiated or at least prompted by the child but can easily lead to transactions in which parents become more dominant and begin to structure interactions that are now clearly instructional in form. In fact, independent of child-initiated discourse, it is parents who frequently initiate diverse instructional activities, especially if the child appears to be having difficulty with a particular task. Over time parents and children develop an instructional partnership, again with reliable and clear expectations emerging on the part of both partners. In this case, the parent is interested in providing and the child is interested and willing to accept this type of more formal instructional support. A substantial literature exists demonstrating the formation and existence of such an instructional partnership including the ability of most parents to sensitively organize and scaffold in an affectively warm and nonintrusive manner a pattern of interactions capable of enhancing their child's knowledge and skills (Vygotsky, 1978). Evaluating their child's "region of sensitivity to instruction," defining attainable goals and subgoals, and shifting levels of support for a problem in a contingent manner along with the child's enthusiastic participation in the process constitute many of the elements of a successful instructional partnership (Pratt, Kerig, Cowan, & Cowan, 1988; Wood & Middleton, 1975). It is this process of adjustment that allows children to internalize solutions and to become more independent

problem solvers. A similar process may also be operating for promoting certain aspects of children's social competence (see Grusec & Davidov, 2010).

Finally, specific forms of sensitive, responsive, and affectively warm interactions displayed by parents that continue to be present over time and are evident in different contexts create the third relationship process, referred to as socioemotional connectedness. Kochanska (2002) has described a shared or mutually responsive orientation that emerges between parent and child. This is a powerful, cooperative, eager relationship that takes many forms. Indeed, the formation of a secure attachment is one critical manifestation of the emergence of this larger relationship process, especially when parents are sensitive and responsive to children's distress signals (Ainsworth, Blehar, Waters, & Wall, 1978; Leerkes, Blankson, & O'Brien, 2009). Of importance, the mutual, cooperative, shared set of expectations helps to support the other 2 types of parent-child transactions (Laible & Thompson, 2000).

These 3 types of parent-child transactions also highlight the fact that a key construct such as sensitive-responsiveness acquires meaning in the context of these relationships (eg, questions, affirmations, support child's focus), different combinations of which may be compatible with 1 or more relationship process (Landry, Smith, & Swank, 2006). As a consequence, the quality of the 3 different relationships may well vary within a given parent-child dyad. This conceptualization is consistent with the domain-specific approach put forward by Grusec and Davidov (2010), focusing on children's socialization. Although the distinctions among the 3 relationship processes constituting parent-child transactions are meaningful and useful, the mutual support and often effortless shifting among them during the ebb and flow of family interactions and routines further enhance the transactional processes.

Connections among all 3 relationship processes that constitute parent-child transactions and the level of child development have been well established. In fact,

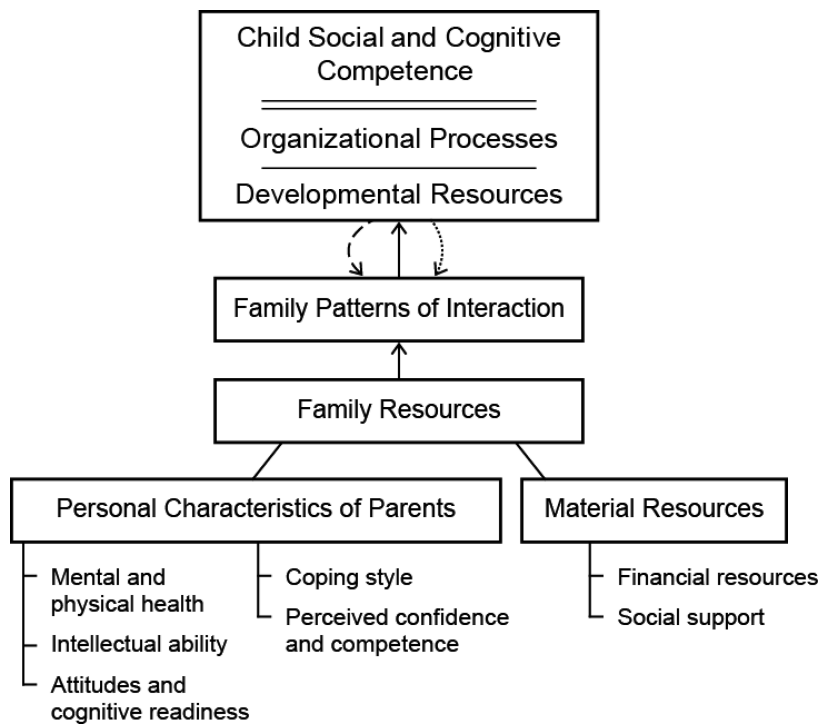


Figure 4. The developmental systems approach framework illustrating the role of family resources as the foundation for the 3 family patterns of interaction.

virtually all aspects of children's developmental resources and organizational processes have been linked to these relationship processes in numerous investigations. A comprehensive review is beyond the scope of this article, but noteworthy examples can be found in the work of Chouinard (2007) for the discourse framework and in the work of Landry and her colleagues with respect to the instructional partnership (see Dieterich, Assel, Swank, Smith, & Landry, 2006). An excellent review of these associations for the relationship process of socioemotional connectedness is also available (Thompson, 2006).

Family-orchestrated child experiences

The contributions of these 3 forms of intense and intimate parent-child transactions to a child's development cannot be underestimated. Yet, parents can further contribute to their child's development by orchestrating

a series of experiences that extend beyond these relationships. As noted in Figure 3, these experiences include introducing the child to the parent's own social network, helping to arrange a peer social network for their child, and providing as stimulating an environment as possible (eg, ensuring the availability of developmentally appropriate toys and materials). Involvement in community activities of all sorts (field trips, shopping, holiday events, etc) also provides numerous opportunities for developmental growth. Of course, the proper selection of child care and preschool programs is of critical importance as well, especially in view of the substantial amount of time many children now spend in those settings. Similarly, it is parents who are responsible for recognizing and supporting their child's special interests as well as recognizing and addressing their child's special needs. All of these family-orchestrated child experiences have established associations with

various components at the level of child development (eg, Bradley & Corwyn, 2004; Dunst, Hamby, Trivette, Raab, & Bruder, 2000; Ladd & Pettit, 2002; NICHD Early Child Care Research Network, & Duncan, 2003). Each component contributes to a child's development not only by reinforcing and extending parent-child transactions but also by introducing the child to the many demands created by different participants and settings. It is this changing goal structure that will challenge the child to apply their developmental resources and organizational processes to achieve goals and display advanced forms of social and cognitive competence.

Health and safety of the child

Finally, parents are also responsible for their child's health and safety, the third family pattern of interaction in the DSA (see Figure 3). Ensuring appropriate nutrition and preventive care such as a proper schedule of immunizations, minimizing child exposure to toxic substances and other environmental hazards, and locating health care professionals to provide proper surveillance and care are only a few of the parental tasks associated with this third family pattern of interaction that influences a child's development (Cole & Winsler, 2010; Stevenson & Krebs, 2009; Strickland et al., 2004). Of course, sheltering children from neighborhood or domestic violence is crucial as well (Osofsky, 1995). Indeed, failure to successfully support a child's health and safety may well have a direct detrimental effect on various components at the level of child development despite the many complex pathways operating and the potential for other biological and environmental factors to mitigate or exacerbate these influences (Hubbs-Tait, Nation, Krebs, & Bellinger, 2005).

Taken together, as is the case for the various components at the level of child development, each of the components of the 3 family patterns of interaction is capable of serving as a risk or protective factor with respect to a child's optimal development. However, it is fair to state that the precise form and outcome

of the interplay among many of these components, particularly across the 3 major categories of family patterns of interaction, have not yet been adequately established by developmental science. Yet, the potential is evident for high-quality components associated with, for example, family-orchestrated child experiences, to be able to buffer or counter the effects of lower-quality parent-child transactions. Indeed, through a pattern of reciprocal influences, children can become more vulnerable or resilient to low-quality parenting through these other experiences (see Bernier & Meins, 2008). The potential interplay between quality of child care and parent-child transactions for children with certain temperamental characteristics provides another important example of this reciprocal pattern of influences that evolves over time (Pluess & Belsky, 2010). The complexity of these "yet to be fully understood" pathways in developmental science that ultimately influence children's social and cognitive competence can be daunting. Nevertheless, for EI practices to be comprehensive, it is essential to address as many of the risk factors as possible at the level of family patterns of interaction resulting from stressors created at the level of child development or due to limited family resources. Indeed, small benefits achieved from each component addressed are potentially capable of generating a powerful cumulative effect on a child's development.

LEVEL OF FAMILY RESOURCES

It is also essential to consider the resources families bring to the task of child development that enable most parents to adjust to the wide variability in children's characteristics, developmental pace, and the daily challenges inherent in family life. In a most fundamental and general respect, children are prepared to learn and to be social and parents are motivated to engage in supportive parenting activities (Papoušek & Papoušek, 2002; Shonkoff & Phillips, 2000). In the absence of significant child vulnerability, when sufficient

family resources are available consistent with optimal levels of family patterns of interaction, correspondingly optimal levels of child social and cognitive competence can be expected. Yet, when these resources are not available to an adequate extent, "intuitive parenting" processes, manifested most clearly in parent-child transactions, may not be evident initially or eventually be overcome by adversity. The result is a highly negative influence on 1 or more of the 3 family patterns of interaction. The specific components of the 2 general types of family resources, personal and material, that are highly relevant to family patterns of interaction are an essential part of the DSA and are noted in Figure 4.

The first family resource, referred to as the personal characteristics of the parents, includes their mental and physical health as well as intellectual ability. Also included here are parents' attitudes toward child rearing and their preparedness to rear their child. These attitudes are often transmitted intergenerationally (Miller, Miceli, Whitman, & Borkowski, 1996) and represent important cultural influences (Keller, 2003). When problems related to their child are encountered, including minor stressors (eg, daily hassles, see Crnic & Low, 2002), parents' positive coping styles and the strategies that emerge serve as resources to maintain the stability of family patterns of interaction. When these and other resources are available and effectively utilized, a sense of a parent's own self-efficacy grows with respect to the parenting role (Crockenberg & Leerkes, 2003).

For material resources, social support can also serve as a highly valuable resource to help optimize family patterns of interaction. This type of support takes many forms including emotional understanding, advice on child rearing, and help locating or providing respite care (Cochran & Brassard, 1979). Networks of social support are quite capable of promoting effective problem solving when parents are faced with stressors and may therefore prevent those stressors from reaching levels that disrupt family patterns of interaction (see Thompson, Flood, & Goodvin, 2006).

Similarly, sufficient financial resources are essential to enable families to engage in supportive family patterns of interaction (eg, access to adequate health care, safe environments, and quality child care as well as having available time and energy to engage in quality parent-child transactions). The critical nature of these material resources is most apparent in the case of chronic economic hardship, as all 3 family patterns of interaction can be easily affected (eg, Bradley & Corwyn, 2004; McLoyd, 1998; Yeung, Linver, & Brooks-Gunn, 2002). As a result of these nonoptimal family patterns of interaction, adverse influences can be found with respect to numerous developmental resources and organizational processes at the level of child development, especially language and executive function (Forget-Dubois et al., 2009; Noble, Norman, & Farah, 2005).

The components of both personal characteristics and material resources can all potentially influence one another in a dynamic way. As was the case for the other 2 levels of the DSA, an array of risk and protective factors with respect to the level of family resources exists. For example, sufficient levels of financial resources and social supports can offer some protection against potential parental mental or physical health problems by creating a network of professional and related supports. Indeed, family patterns of interaction often remain stable despite the many challenges to various components of a family's resources. At the same time, as has been well documented, when risk factors associated with some combination of personal characteristics of parents or material resources dominate, with little mitigation from protective factors, family resources can easily become depleted (Burchinal et al., 2000; Sameroff, et al., 1987). The resulting breakdown of adaptive processes typically involves all 3 family patterns that influence child development. Clearly, comprehensive efforts to support children's development through EI must also consider all aspects of family resources to optimize the 3 family patterns of interaction.

INFLUENCE OF CHILD CHARACTERISTICS

Fortunately, even if parent adaptations are not always completely adequate, the expected developmental course of most children without major biologically based vulnerabilities is nevertheless unaffected. In part, this is due to the promoting influences of unaffected high-quality family patterns of interaction. However, another critical source of protective factors is the children themselves. In fact, because of a genetic predisposition or prior positive experiences, many children are resilient in the face of various types of even significant adversity created by nonoptimal family patterns of interaction (Propper et al., 2008). For example, children's socioemotional connectedness in the form of a secure attachment can protect them from adverse developmental outcomes due to experiencing nonoptimal parent-child transactions associated with later emerging but chronic levels of maternal depression (Milan, Snow, & Belay, 2009). As another example, certain genetic factors can often protect children from even the most damaging of parent-child interactions (Bernier & Meins, 2008; Caspi & Moffitt, 2006).

Many vulnerable children, however, that is, particularly those at biological risk or with an established disability, appear to be far less resilient, lacking the ability to tolerate as much variability in the quality of family patterns of interaction to maintain as optimal levels of development as possible. For example, the language development of children with early brain damage is clearly compromised by the absence of high-quality parenting in the form of parent-child discourse whereas children without this vulnerability can tolerate less reliable and consistent speech directed toward them without suffering these adverse effects (Rowe, Levine, Fisher, & Goldin-Meadow, 2009). It appears then that the extent and nature of a child's vulnerability at a given time can be a major factor in moderating the influence of family

patterns of interaction. The broken arrows in the figures in this article reflect this moderating influence of children's characteristics, a consideration especially relevant for vulnerable children.

The problem of less resilience to nonoptimal family patterns of interaction for children born at biological risk or those with an established disability is further compounded by the fact that parents of vulnerable children experience far more difficulty adjusting to their children's characteristics. Indeed, parents' ability to adjust family patterns of interaction to their vulnerable children is often substantially compromised as a result of the unusual and often uneven developmental and behavioral patterns displayed by the children as well as the complexity of the components that constitute their child's developmental resources and organizational processes. Significant child health problems add to these difficulties. The fact that many of the adjustments required as a result of vulnerable children's characteristics may well exceed parents' skills or knowledge, or even escape their awareness, is illustrated by the solid arrows extending from the level of child development to the level of family patterns of interaction indicated earlier in Figure 1. As noted, these "downward" influences are conceptualized as stressors within the DSA; with each stressor capable of perturbing the various components in 1 or more of the 3 family patterns of interaction.

There exists ample documentation in the risk and disability literature demonstrating how the characteristics of vulnerable children can potentially stress all aspects of the system of family patterns of interaction (Guralnick, 1997, 1998). Parent-child transactions are especially susceptible to these influences, often because of the increased levels of child irritability and behavior problems, reduced initiative of children in social contexts, unevenness both within and across children's developmental resources and organizational processes, and the difficulties parents experience detecting and understanding children's cues and feedback (see Spiker, Boyce,

& Boyce, 2002). Given these circumstances, it is easy to see why problems establishing a discourse framework, an instructional partnership, or socioemotional connectedness can easily occur. A similar process exists in making appropriate adaptations for children at environmental risk. As these children begin to exhibit lower than expected social and cognitive competence, parental adjustments during parent-child transactions become even more difficult to achieve (Lugo-Gil & Tamis-LeMonda, 2008). This further compounds the problems already affecting parent-child transactions created by limited family resources. Accordingly, it appears that many vulnerable children will require substantial and sophisticated adjustments to enable parent-child transactions to occur optimally. The challenge is to provide predictable, finely tuned, often highly specialized and perhaps more repetitive forms of interacting. Clearly, EI programs can serve to promote this process in families.

Similar challenges for parents of vulnerable children exist for the other 2 family patterns of interaction. With respect to family-orchestrated child experiences, examples include difficulties making proper child care arrangements, encountering barriers when seeking to find playmates to be included in their child's peer social network, and problems participating in community experiences in which both the parent and child feel welcome and comfortable (Guralnick, 2006). Indeed, social isolation and exclusion can become serious concerns for all family members. To some extent, these difficulties are the result of macro-level forces, such as societal attitudes and beliefs about and comfort with individuals with disabilities. Nevertheless, child characteristics associated with vulnerable children clearly constitute potential stressors for family-orchestrated child experiences, thereby increasing the risk factors governing children's social and cognitive competence.

Even when professional help is obtained by parents as their child's developmental problems become apparent, the recommendations that follow can be complex, confusing, and

even contradictory. Without question, recruiting and organizing professionals can often be an overwhelming task even for the most conscientious of parents, and service coordination continues to be a major challenge in the EI field (Bruder, 2010). All of this is made far more difficult for the many children at risk and those with established disabilities who face more frequent and certainly more complex health issues than children without these vulnerabilities. Indeed, parental adjustment to ensure the health of vulnerable children and their safety is a constant challenge, easily stressing the entire system of family patterns of interaction (eg, Roizen & Patterson, 2003).

It is important to emphasize that difficulties adjusting to children's developmental and behavioral patterns certainly do not overwhelm all or even most families of vulnerable children. Numerous accommodations and adjustments in routine activities are often successfully achieved by parents and enable their children to develop in the most optimal manner possible (Gallimore, Weisner, Bernheimer, Guthrie, & Nihira, 1993; Guralnick, Neville, Hammond, & Connor, 2008). Generally speaking, successful adjustments by parents of vulnerable children are especially likely when adequate family resources are available.

As discussed earlier, children at risk due to environmental factors are particularly vulnerable to the cumulative risks associated with both personal and material family resources. Noted as well, these family risk factors operate to influence children's development by adversely affecting 1 or more of the 3 family patterns of interaction. However, even in the initial absence of environmental risk factors, family resources can nevertheless become compromised over time when a child at biological risk or one with an established disability is involved. That is, chronic, sometimes severe, child-based stressors can exact a heavy toll upon many of the personal and material components of a family's resources (represented by the line from the level of child development to the level of family resources in Figure 1). For example, excessive personal

demands due to their child's health concerns and behavior problems as well as family distress created by recognition of the implications of their child's expected developmental trajectory can affect parent's mental and physical well-being. Moreover, added financial burdens and challenges maintaining their social support networks can substantially deplete material resources. Stressors to family resources may also combine to diminish parents' beliefs with respect to their ability to cope and be effective parents (see Orsmond, 2005). Taken together, the consequence of this process of reciprocal influence of stressors across the 3 levels of the DSA for vulnerable children is to potentially create a cycle of incremental developmental vulnerability over time (see Figure 1).

IMPLICATIONS FOR EARLY INTERVENTION

Despite some uncertainties, considerable confidence exists that the reciprocal patterns of influence that operate across the 3 levels of the DSA for normative development constitute causal relationships (Collins et al., 2000; O'Connor, 2002). Moreover, a major assumption of the DSA is that all of the interrelationships and mechanisms of influence described earlier in connection with the developmental science of normative development apply equally well to children who are vulnerable. Extensive evidence does, in fact, indicate that these pathways of influence operate as expected for children at risk due to environmental factors (Evans, 2004). Admittedly, however, for children at biological risk and those with established disabilities, there has not been nearly as comprehensive a program of research carried out to confirm these interrelationships and mechanisms. Nevertheless, when this has occurred, especially in critical areas such as constructs related to sensitivity and responsivity, similar patterns of association and influence have been found (eg, Dunst, 2007; Dunst & Trivette, 2009; Warren & Brady, 2007). Consequently, in the most fun-

damental way, the core-working hypothesis of the DSA as applied to early intervention for all vulnerable children is that effectiveness depends upon the program's ability to establish or restore as optimal a level of family patterns of interaction as possible. As we have seen, developmental science has provided useful guidelines with respect to how parents can optimize development. As discussed shortly, it is now necessary to develop comparable assessment instruments that can be applied in EI settings to structure effective intervention approaches. In many respects, then, this systems perspective provides a framework for understanding why EI works when it does as well as suggest directions for alternative approaches when problems are encountered.

From the perspective of intervention science, close inspection of those EI programs that have been effective at some level does indeed suggest consistency with this hypothesis. Specifically, for the most part, effective interventions have produced an array of resource supports, social supports, and information and services that appear responsive to the many stressors affecting family patterns of interaction as identified in the DSA (see Spiker, Hebbeler, & Mallik, 2005, for a review). Most notable are interventions to promote all 3 forms of parent-child transactions. Even for children presenting with highly complex and unusual developmental and behavioral patterns, such as those diagnosed with autism spectrum disorders, building relationships with both parents and therapists has been a central theme (Dawson et al., 2010; Mahoney & Perales, 2003). As to be expected, interventions have ranged widely, including highly child-focused strategies aimed toward daily skill development, behavior management in playgroups and preschools, and school readiness activities designed to help children and families take advantage of natural learning activities (Carta & Kong, 2007; Dunst, et al., 2000). Support through parenting groups, respite care services, and health supervision provided by establishing a medical home are among other forms of intervention addressing stressors (Moeschler, 2009).

Of note, of the EI programs that have proven to be effective, most have been able to prevent to varying degrees the decline in children's competence that normally occurs in the absence of systematic EIs (Guralnick, 2005a). Presumably, the gradual decline of competence in the first few years of a vulnerable child's life without EI in comparison to children without major vulnerabilities is related to the cumulative adverse influence of stressors operating over time as represented by the patterns of influence proposed in the DSA. This interpretation, as well as other empirical findings from EI programs that are consistent with the DSA, does not, of course, constitute a meaningful evaluation of the relationships and mechanisms that have been described. Over time, intervention science based on approaches consistent with or derived from the DSA will provide opportunities for more formal testing of the patterns of influence suggested by the DSA and contribute to a better understanding of the value and limits of the core hypothesis.

Consideration of the DSA framework does, however, provide a way to organize the diverse interventions that have been applied and to help understand the reasons for the outcomes that have been achieved. Relatedly, consideration of the DSA in the context of EI encourages systems thinking that integrates the developmental science of normative development, research focusing on risk and disability, and intervention science. Combined with clinical experience, it is this integration that provides the conceptual and empirical basis for the practices of EI for vulnerable children and their families.

Assuming that this systems approach does, in fact, represent an accurate understanding of the mechanisms with respect to why EI works, it is evident that the highly diverse conceptual and practice approaches to EI that currently exist noted at the outset of this article may be severely limiting our ability to maximize the effectiveness of these programs (Dunst, 2007). Indeed, substantial concerns exist with respect to the wide variability and fractionation of EI services especially in the

face of increasing heterogeneity and complexity of family and child needs (Bruder, 2010). Absent in EI service systems is the type of systematic approach firmly grounded in developmental and intervention science that may well be necessary to truly maximize effectiveness. As a consequence, many stressors are not easily identified or addressed in a conceptually unified way in EI programs. The consequence of this is to miss opportunities to create the cumulative impact on the 3 family patterns of interaction required to fully support children's social and cognitive competence. In view of these circumstances, potentially major contributions of systems models such as the DSA to EI is their emphasis on comprehensiveness within a well-defined conceptual model, articulation of those environmental processes and events crucial to a child's development and how they operate to influence that development, and providing an understanding of the interrelationships among the various components and levels of the system that together contribute to children's cognitive and social competence. With the DSA as a framework, some areas for future consideration in the field of EI are discussed next.

Tasks for the future

As noted, within the DSA, the central task of EI is to establish or restore family patterns of interaction to as optimal a level as possible. Consequently, after obtaining available information regarding a child's developmental status, an ideal way to begin is to establish an assessment process focusing on that level. In fact, numerous and excellent assessment tools are available that are potentially relevant to each of the components of the 3 family patterns of interaction (Guralnick, 2005b). However, an assessment strategy based on the DSA calls for both a reorganization and a redesign of existing instruments, including laboratory measures, interviews, rating scales, and standardized tests, to create tools that can be feasibly, comfortably, and efficiently utilized in EI settings. Accomplishing this task will require considerable effort, even when guided by an

explicit conceptual framework such as that provided by the DSA. Consider for a moment assessment protocols required for all 3 components of parent-child transactions. Clearly, at 1 level, separate measures of the quality and frequency of engagement relevant to a discourse framework, an instructional partnership, and socioemotional connectedness are needed. In addition, each measure must focus on the relationship features of the 3 forms of parent-child transactions, recognizing that evidence of the relationship and its nature varies at different points in a child's development. Consideration of a child's developmental status is therefore critical (see later). Similar, although perhaps more straightforward measures are needed for the various components of family-orchestrated child experiences and health and safety provided by the family. Many of the measures for these 2 family patterns of interaction can be adapted from existing tools and organized within the DSA framework as well.

Ideally, this assessment process should be viewed as a partnership among the parents, child, other relevant parties, and EI professionals. Including interviews and observations of interactive tasks tied to the child's developmental level at minimum would not only provide important information for EI professionals but also constitute an introduction for the family to the goals of EI, that is, optimizing all components of the 3 family patterns of interaction. For example, interview questions that capture issues with respect to a parent's ability to support their child's problem solving (scaffolding in an instructional partnership) or how parents elaborate on their child's questions or verbalizations (responsivity as part of the discourse process) or the extent to which their child uses the parent as a secure base from which to explore (socioemotional connectedness) can be used as one basis for developing a profile of parent-child transactions. A preliminary framework consistent with some of these DSA components has been developed (Bailey & Powell, 2005).

To further inform this assessment of risk and protective factors at the level of fam-

ily patterns of interaction, EI professionals should utilize as much information as possible from assessments at the level of child development. This information should emphasize both current levels of children's social and cognitive competence as well as their developmental resources and organizational processes. Follow-up medical and interdisciplinary assessments may also yield useful diagnostic/etiologic information that can highlight potential stressors that families may not have considered, as well as provide a more complete understanding of the stressors already identified. Standardized tools are certainly available for children's developmental resources, but this is not the case for most of the organizational processes, especially in the context of EI. Developing such feasible assessments on the basis of the many useful experimental measures that are available would constitute another important task within the DSA (eg, see Carlson, 2005, for executive function measures for preschool children).

The value of obtaining a profile of risk and protective factors at the level of child development should not be underestimated. This is especially the case for children with a categorical diagnosis, a known etiology, or well-defined risk factors, as knowledge of expected developmental patterns or profiles for these subgroups of children can also highlight special concerns as well as developmental strengths. Moreover, certain risk and protective factors at the level of child development may even suggest specific approaches to interventions. For example, many children at high risk due to environmental factors do not adequately respond to seemingly comprehensive interventions and, whatever developmental gains that do occur, often diminish (Ludwig & Phillips, 2008). Evidence suggests that this difficulty may be associated with the organizational process of executive function, and a recently developed intervention targeting executive function problems mainly by enhancing a teacher-based instructional partnership for these children is highly promising (Diamond, Barnett, Thomas, & Munro, 2007). This strategy can be combined with existing

interventions focusing on enhancing various aspects of parent-child transactions that can also influence executive function (Landry, Miller-Loncar, Smith, & Swank, 2002).

This process, in which basic knowledge of children's developmental characteristics at the behavioral level is translated into well-designed interventions, can be applied to other subgroups of children as well. Information relevant to etiologic-specific subgroups of children in particular, such as those with Fragile X or Down syndrome, or indeed subgroups defined within the autism spectrum, can potentially provide useful directions for innovative interventions. As additional details about developmental processes associated with specific subgroups become available (Hodapp, DesJardins, & Ricci, 2003), they will contribute to the design of intervention strategies that will most effectively optimize family patterns of interaction.

Decisions regarding the priorities and directions for intervention based on assessments of risk and protective factors at the level of family patterns of interaction and the level of child development will certainly be influenced by a family's resources. In fact, family resources may be the central concern that initially places a child at risk for developmental problems (environmental risk). In this case, the primary focus is on preventive interventions designed to minimize the adverse effects on nonoptimal family patterns of interaction. To organize this process for children at risk as well as for those with established disabilities, an assessment process with respect to the personal characteristics of the parents and material resources available should be carried out. As noted, many families do have sufficient resources early on that can be accessed but the possibility that stressors will deplete a family's resources due to a vulnerable child's characteristics over the course of the early childhood period is considerable. Relevant tools at this level exist but also need to be reorganized and redesigned to conform to the components of family resources of the DSA and to be consistent with the partnership format of the assessment process.

Clearly, EI professionals must be careful to avoid being intrusive and be certain to respect the privacy of families. It is also the case that an assessment of family resources might suggest that certain interventions focusing on some components of family patterns of interaction, such as aspects of parent-child transactions, may not be feasible because of overwhelming problems at the level of family resources. Approaches may be needed for families at unusually high environmental risk, in particular, that include a much larger commitment on the part of the EI program to directly intervene with the child while concurrently seeking to promote more optimal family patterns of interaction and to address risk factors identified at the level of family resources. In essence, enrollment of their child even as an infant or a toddler in an EI program that has an intensive child-focused component constitutes an acceptance by families of the importance of this type of family orchestrated child experience.

The DSA also provides a framework to guide EI professionals who, for a variety of reasons, are working more directly with children. Indeed the 3 relationship processes central to parent-child transactions are highly relevant to the formation of professional-child transactions. This task is most easily accomplished when the EI program involves a one-to-one professional-child intensive intervention model. But such interactions with the child can also be carried out in group care environments, especially with adequate professional-child ratios. The key point is that the developmental mechanisms for supporting children's social and cognitive competence remain, irrespective of the environment.

It is important to emphasize that, even with relatively intensive one-to-one professional-child involvement, meaningful and long-term intervention outcomes will depend on ensuring optimal family patterns of interaction, including parent-child transactions. This is certainly the case for interventions in group care settings in which children participate for only a limited period. Even preschool programs

that provide one-half day or more of services cannot replace the need to support families. Without doubt, the skills obtained by children in preschool settings regarding following directions in complex group environments, expanding their information associated with the conventional domains that constitute children's developmental resources, figuring out how to regulate their emotions when interacting with peers, and many others are vital for development and for school readiness. However, continuing to involve families as part of an EI program in a way that addresses stressors identified in the DSA will certainly require a model for pre-school-aged children that does not commonly exist today.

Perhaps one of the most difficult tasks for the future is to create decision rules and establish intervention priorities based on this multi-level assessment. Examination of risk and protective factors and the reciprocal influences illustrated in Figure 1 both clarify opportunities and highlight constraints with respect to optimizing family patterns of interaction. To be sure, EI professionals are able to draw upon the many strategies that intervention science has already found to be valuable. However, as has been argued, a coherent and systematic process is needed to guide this selection of strategies; that is, they must be considered as part of the larger context of goals. The DSA was developed to provide that context. To be more concrete, strategy selection must be driven by questions such as the following: "How will this strategy enhance a discourse framework?"; "How can this approach foster socioemotional connectedness?"; "How can a family's social support network be strengthened?"; and "What special considerations exist at the level of child development?" In this way, professionals, parents, and others involved are able to better appreciate the mechanisms and overall goals of the intervention process and its deep roots in developmental science.

A number of steps will be required to transform this approach into a feasible process that guides intervention goals and strategies. Within this framework, a sequence would begin by identifying preliminary intervention

goals (short- and long-term) based on a thorough assessment of a family's pattern of interactions noted earlier. Although the assessment itself would have been guided by the child's developmental status and chronological age, these considerations should be reviewed once again at the point where intervention goals are being selected. Consideration of a child's developmental level when establishing intervention goals related to a discourse framework, for example, would be especially important. Equally important is consideration of a child's chronological age when focusing on helping to support community activities or fostering peer social networks. In this way, the value of inclusive experiences is recognized. Moreover, it is at this goal-setting stage that the details of risk and protective factors at the level of child development should be brought into focus. Behavior control issues (emotion regulation), a low level of child initiative (motivation), or unusual executive function problems may all require special considerations. These special considerations would affect both the selection and the modification of any evidence-based intervention strategies in support of the goals selected. Finally, the intervention planning sequence would address the risk and protective factors identified in the assessment of a family's resources. Goals at that level would focus on the selection of strategies directed at areas of concern as well as the influence a family's resources might have on the feasibility of goals being considered at the level of family patterns of interaction. Of course, an evaluation process for individual goals selected at each level must be included in the planning.

Although presented as a sequence with distinct elements, this complex process is inevitably nonlinear and iterative. Even with well-established algorithms for identifying risk and protective factors, as well as selecting and prioritizing goals, the fact remains that EI is most fundamentally a clinical process relying on the expertise and experience of all those involved. This is apparent at the early stages of intervention planning but is certainly the case as information from the evaluation of

selected goals and related information from clinical experience with the child and the family become available over time.

CONCLUSION

The DSA provides a framework for understanding why EI works in its current form as well as how to proceed to create even more comprehensive and effective EI programs. A number of important factors are central to this approach. First, the design, implementation, and evaluation of EI practices must be placed well within a framework that integrates the developmental science of normative development, research specifically addressing children at risk and those with an established disability, and intervention science. Second, the DSA emphasizes not only the centrality of families but also the centrality of relationships and how they operate to promote a child's development. Third, consideration of the interplay of risk and protective factors at all 3 levels of the DSA constitutes a key element of the approach. Fourth, the systems perspective that

is at the core of the DSA applies within all 3 levels as well as across all 3 levels, thereby reflecting the many reciprocal influences on child development.

The DSA, then, constitutes a conceptual and structural framework that can serve as a basis for the design and redesign of community-based EI systems (see Guralnick, 2001). In many respects then, it can serve as a guide for future policies in the EI field to address, among others, quality concerns when taking programs to scale, minimizing fragmentation of services, ensuring that intervention strategies are science-based, and providing an approach that strongly encourages innovation (Shonkoff, 2010). Many elements consistent with the DSA are already in place because of the creative efforts of numerous EI professionals. Further advances within a systems perspective will now require somewhat different approaches to assessment, decision making for program planning and implementation, and evaluation. This is a complex, challenging, but by no means insurmountable task.

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