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COGNITIVE AND LINGUISTIC BUILDING BLOCKS OF EARLY LITERACY

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A Window of Opportunity We Must Open to All: The Case for Preschool with High-Quality Support for Language and Literacy

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Countries seeking to educate citizens equipped with the literacy skills needed for skilled jobs in this technological era must provide children from low-income families with center-based preschools that offer substantially stronger support for language and early literacy skills than what is commonplace today. In this chapter we provide evidence from multiple domains to support this proposition. After documenting the shortcomings of our educational system, we argue that the years between 3 and 5 are especially important for long-term development. We substantiate this claim with developmental research from three broad areas: (1) early literacy, (2) social and emotional development, and (3) brain development. Theory and research findings from these areas are reviewed and interpreted as indicating that linguistic, cognitive, and affective domains are all critical to long-term literacy development. These domains are shown to be interrelated, with synergistic interdependencies appearing in the later preschool years that result in increasingly well-orchestrated systems of interrelated linguistic, cognitive, and affective/regulatory abilities. Next we briefly review studies conducted in early childhood classrooms and find that they can play an important role in supporting children's language development. Unfortunately, other research that has examined interaction in preschool classrooms reveals serious limitations in the extent to which the average classroom that serves low-income children provides optimal support for language. We conclude by discussing some of the steps we see as necessary if we are to significantly improve the ability of classrooms to nourish children's early development.

Why We Need High-Quality Preschool Classrooms

An extensive literature documents large and predictable gaps between children from more and less advantaged socioeconomic backgrounds in the United States (Bishop & Edmundson, 1987; Dickinson, 1987; Hart & Risley, 1995; Strickland, 2001; Tarullo & Zill, 2002; Whitehurst & Lonigan, 1998,

2001) and other industrialized societies (Leseman & van Tuijl, Chapter 16, and McNaughton, Chapter 17, this volume). Predictable factors place children at risk of entering kindergarten with limitations in literacy-related skills: Their parents have limited education and economic resources, their ethnicity and/or first language is not that of the mainstream community and is not valued by the majority culture, and their family does not engage in the type of discourse that has been found conducive to acquisition of early literacy skills (Hart & Risley, 1995; Hoff, Chapter 12 and Leseman & van Tuijl, Chapter 16, this volume). When these early problems are combined with the problem of elementary schools that are not successfully bolstering children's phonemic awareness (see Biemiller, Chapter 3, Burgess, Chapter 7, Morrison, Connor, & Bachman, Chapter 26, and Lonigan, Chapter 6, this volume), many children are left at significant risk of failing to acquire high-level literacy skills.

Although such factors place children at risk, longitudinal research indicates that high-quality interventions during the preschool years can have enduring effects on a broad range of developmental outcomes (see Barnett, Chapter 25, and Ramey & Ramey, Chapter 31, this volume). Unfortunately, preschool classrooms that serve the population in need of strong early support do not consistently have a major impact on supporting children's development. Head Start, the government's flagship program that seeks to level the playing field for children from low-income homes, has substantially increased its attention to early academic skills, with benefits being seen in children's language and literacy skills (see Zill & Resnick, Chapter 26, this volume). Nonetheless, we are still far from providing the level of care required to substantially enhance the academic opportunities of children who depend on these classrooms for educational nourishment.

The slow pace of improvement is not surprising. The early childhood system employs staff who have limited education, are poorly paid, and work in a low-status profession, often under difficult circumstances. High levels of attrition are but one outcome of this unfortunate convergence of circumstances (Dickinson & Brady, 2005). Added to the problems that flow from financial constraints on the entire early childhood system are the conceptual changes that are required. Pianta (Chapter 11, this volume) argues that teachers of young children feel a tension between supporting children's emotional growth through warm and supportive relationships and teaching children information and skills. He argues that the act of explicit instruction often is experienced as a threat to their ability to nourish children's emotional growth. The power of such ways of viewing teaching has helped shape how the broader preschool world has viewed classrooms, with support for literacy too often seen as standing in opposition to support for social and emotional development. This either/or trade-off view was reflected even in the landmark review of research on early childhood programs, *Neurons to Neighborhoods* (Shonkoff & Phillips, 2000), which, in its final summary, included a caution against overemphasis on cognitive goals at the expense of social and emotional goals. We must move beyond such thinking to recognition of the need to address all aspects of development effectively.

Literacy Development from a Systems Perspective

Literacy development can best be understood from a systems perspective (Ford & Lerner, 1992; Nelson, 1996) in which language plays a prominent early role in organizing cognitive and other affective–behavioral systems that support literacy-related activity. Extensive research on early literacy now indicates that language skills broadly conceived—vocabulary, syntax, and discourse, as well as phonemic awareness—are central to early and long-term literacy success and that children reap added rewards when they develop these language and literacy-related capacities in tandem so that interconnections among systems can be fashioned into mutually reinforcing systems (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003). But long-term literacy and associated academic success require more than acquisition of perceptual, linguistic, and cognitive skills that enable one to read and understand. One also needs to acquire the social and affective–behavioral self-regulatory skills needed to relate effectively to teachers and peers, to at-

tend to difficult tasks, and to develop the motivation that enables one to become a self-sustaining learner. Thus a fully satisfactory theory of the development of early literacy must take into account the interrelationships among language and print-related skills (e.g., letter knowledge, knowledge of sound–symbol correspondences) and consider the interactions among social development and self-regulatory and motivation processes (Dionne, Tremblay, Voivin, Laplante, & Perusse, 2003; Pianta, 1999).

The complexity of such an undertaking is staggering, but it is possible to narrow our focus in a manner that makes the task somewhat less daunting. We hypothesize that language plays a powerful role in the organization of all these systems. Between the ages of 3 and 6, the rapid development of language, particularly the emergence of the more advanced language abilities, may play a pivotal role in the initial organization and subsequent functioning of varied linguistic–cognitive–affective systems that underpin literacy, as well as diverse areas of cognition and social development (Dickinson et al., 2003; Nelson, 1996; Pianta, Chapter 11, this volume; Tomasello, 2000). This perspective has been summarized by Katherine Nelson (1996), who reviewed research from multiple domains including theory of mind, memory, conceptual skills, and narrative, and linked these developmental shifts to the language abilities that become available during this period. Nelson stated that between ages 2 and 6 "language and the surrounding culture take over the human mind. It is during these years that biology 'hands over' development to the social world" (p. 325).

This view of development is consistent with Tomasello's (2000) argument that human cognition is largely the by-product of evolutionary factors that led to the development of the ability of people to understand the perspectives of others and the refinement of abilities to communicate knowledge using language. Both Nelson and Tomasello advance positions that are consistent with two key Vygotskian principles outlined by Bodrova and Leong (Chapter 18, this volume): (1) that mental development results from natural development and cultural development and (2) that the formation of higher mental functions is the major development during the early childhood period.

Recently we reviewed the research on early language and literacy development (Dickinson et al., 2003) and stressed the central role of multiple language abilities in early and later literacy. We hypothesized that early language and print-related abilities may emerge as interdependent systems. Considerable evidence demonstrates that literacy draws on a number of levels of the language system, with these abilities encompassing vocabulary (Biemiller, 1999; Bishop & Adams, 1990; Butler, Marsh, Sheppard, & Sheppard, 1985; Hart & Risley, 1995; Scarborough, 1989; Share, Jorm, Maclean, & Matthews, 1984; Storch & Whitehurst, 2002; Walker, Greenwood, Hart, & Carta, 1994), syntax (for reviews, see Biemiller, 1999; Dickinson, 1987), and discourse (Beals, 2001; Bishop & Edmundson, 1987; Fazio, Naremore, & Connell, 1996; Feagans & Applebaum, 1986; Menyuk et al., 1991; Vernon-Feagans, Hammer, Miccio, & Manlove, 2001). Literacy also draws on the ability to attend to and manipulate the sounds of language. The vital role of phonological sensitivity also has been demonstrated through longitudinal observational studies (Bryant, MacLean, & Bradley, 1990; MacLean, Bryant, & Bradley, 1987; Stanovich, 1992; Vellutino & Scanlon, 2001; Wagner & Torgesen, 1987; Wagner et al., 1997; Whitehurst & Lonigan, 1998) and intervention studies (Ball & Blachman, 1991; McGuinness, McGuinness, & Donohue, 1995).

Although research has tended to correlate reading skill with language functioning in distinct areas, there is considerable evidence that, in the developing child, language ability is not rigidly restricted to the categories we use to describe language. Evidence for this point comes from Scarborough (2001), who conducted a meta-analysis of the impact of oral language on subsequent reading abilities and concluded that successful predictors of future reading abilities usually have not been confined to a single linguistic domain. Indeed, Scarborough suggests that, at different points in development, reading problems may be traced to language-related deficiencies that take different forms at different points in development.

Of course, early reading involves processes and knowledge other than those closely linked to language. In particular, skill in recognizing and interpreting print is vital

(Dickinson et al., 2003; Lonigan, Burgess, & Anthony, 2000; Lonigan, Burgess, Anthony, & Barker, 1998; Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998, 2001), as indicated by the fact that the ability to identify and name letters has long been recognized as being a strong predictor of later reading (Adams, 1990).

Several decades of intensive study of the importance of distinct domains to early literacy have resulted in abundant evidence of the multiplicity of factors that support the emergence of literacy. In the coming decades researchers will need to examine the interconnections among these diverse domains. Analyses we conducted of data from 4-year-olds suggest that phonological sensitivity, vocabulary, and print skills are correlated and, among normally developing children, are fashioned into mutually reinforcing systems of knowledge. Other studies reported in this volume (see especially Leseman & van Tuijl, Chapter 16; McNaughton, Chapter 17; and Sénéchal, Ouelette, & Rodney, Chapter 13) support the proposition that reading success is based on development of multiple skills, with the centrality of different skills varying by the age of the child and the reading demands encountered at a given age.

A hypothesis that flows from a systems view of development is that the opportunity to substantially affect the nature of the system is greatest at the point at which the processes that are involved are initially being fashioned into a stable, interconnected network. Some data from studies of the emergence of phonemic awareness suggest that this dynamic may be present for literacy-related skills. Studies of the emergence of phonological sensitivity in the preschool years (Lonigan, Chapter 6, this volume; see Burgess, Chapter 7, this volume, for a review), indicate that very young children have some capacity to attend to the sounds of language but that these abilities are not organized enough to enable children to demonstrate consistent access to phonological representations of language. The youngest children show variability from one task to the next and from one point in time to the next. However, as children approach age 5, more stability is apparent, suggesting that these abilities are beginning to be organized into stable systems.

Consistent with this speculation is evidence that the preschool years are a time when literacy-specific aspects of development may be particularly responsive to intervention. The National Reading Panel's review of studies seeking to improve phonemic awareness found that the few studies that involved kindergarten-age children, the youngest group included, had the strongest effects of any age period, with an average effect size nearly double those found for interventions carried out with older children (Ehri et al., 2001). Correlational studies have also provided evidence of the impact of preschool classrooms on emerging aspects of children's language skill. Huttenlocher, Vasilyeva, Cymerman, and Levine (2002) examined the growth of low-income 4-year-old children's syntactic skills over the course of 9 months. Taking into account the impact of maternal language use, they found that the syntactic complexity of teachers' language played a substantial role in accounting for children's fall-to-spring syntactic development.

The Home–School Study of Language and Literacy Development (Snow & Dickinson, 1991), a longitudinal study that examined both home and classroom factors that support the language and literacy of children from low-income families, also found clear evidence that teachers' language use can have significant effects on children's emerging language and literacy skills (Dickinson & Tabors, 2001). When children were 4 years old, their classrooms were visited and coded for educational support, and their teachers were interviewed and recorded throughout the course of one day. Regression analyses found that, after controlling for the children's language skill at age 3 (mean length of utterance during a play episode at home) and family demographics (income, education), the nature of extended discourse involving teachers added significant explanatory power to the models. For example, when predicting vocabulary, the control variables accounted for 18% of end-of-kindergarten variance, and, when a composite measure of teachers' extended discourse was added, the amount of variance accounted for jumped to 41%. In a recent reanalysis of these data, we found that these effects could still be detected at the end of fourth grade. Using stepwise hierarchical regression that controlled

for home demographic factors (i.e., maternal education and family income) and the child's mean length of utterance (MLU) at age 3, we found that measures of teacher discourse accounted for significant ($p < .01$) variance in end-of-fourth-grade assessments of vocabulary and reading comprehension (Dickinson & Porche, 2005).

Experimental and correlational evidence suggest that language may be particularly malleable during preschool. If true, this is of considerable importance, because longitudinal studies of vocabulary learning have also provided strong evidence of stability in vocabulary growth (Biemiller, 1999; Cunningham & Stanovich, 1997) and evidence that schools are apparently not successfully fostering vocabulary growth (Biemiller, Chapter 3, this volume; Morrison et al., Chapter 26, this volume). Similarly, Storch and Whitehurst (2002) examined development of vocabulary from preschool through third grade, and at each step the vocabulary scores from the previous year accounted for 88% or more of the variance of the subsequent year. Long-term stability also is present, as Tabors, Snow, and Dickinson (2001) found kindergarten-to-seventh-grade correlations in receptive vocabulary of $r = .63$. Analyses of child outcomes between kindergarten and fourth grade using growth modeling found that kindergarten Peabody Picture Vocabulary Test (PPVT) scores and word recognition were strongly predicted by preschool home and classroom variables. Fourth-grade reading comprehension was strongly predicted by kindergarten vocabulatry and reading controlling for kindergarten–grade 4 rate of growth (Tabors, Porche, & Ross, 2003).

Typically, children who enter kindergarten or first grade substantially behind age norms do not make the gains they need in order to leave school with strong academic skills. High correlations have been reported between kindergarten vocabulary skill and seventh-grade reading (Tabors, Snow, & Dickinson, 2001), as well as reading in first and fourth grades (Juel, 1988). High correlations also were reported between reading achievement in first grade and at the end of high school (Cunningham & Stanovich, 1997). The need for early intervention is further indicated by the fact that, after children reach third grade, reading difficulties are far less amenable to remediation (Good, Simmons, & Smith, 1998; McGill-Franzen & Allington, 1991).

Thus multiple language abilities are central to the emergence of literacy during the preschool years and continue to play a major role in later reading success. These abilities develop with great speed during the preschool years, and, as children enter school, selected capacities are recruited for reading and writing. There are hopeful indications that development may be particularly malleable during this era; considerable evidence suggests that as children get older it becomes increasingly difficult to substantially alter their chances of long-term academic success.

Self-Regulation, Social Skills, and Language

Extensive research has been done on the emergence of children's social skills and the importance of self-regulation. Work on social and emotional development comes from varied theoretical perspectives, with the socially based perspective of Tomasello (2000) and Nelson (1996) being particularly relevant to our argument because of the central role accorded to language. Tomasello (2000) argues that the ability to identify with the perspectives of others, combined with the ability to use language, enables people to communicate their mental states and intentions, thereby providing a very powerful means to transmit values and knowledge. Other researchers interested in social and emotional development, especially those focused on the role of cognition (e.g., Saarni, 1999), have also recognized the importance of language in children's emotion-related capabilities. When language is viewed in this way, it becomes evident that, as children learn to use language, they acquire a tool that enables them to regulate their own emotions and behaviors, with important consequences for their social and academic functioning.

Self-regulation refers to the ability to initiate, sustain, modulate, or change the intensity or duration of feeling states in order to achieve one's goals (Baumeister & Vohs, 2004). The capacity for self-regulation is in-

creasingly coming to be seen as essential to social development and to the ability to learn in school. Preschoolers with effective regulatory skills are better able to form positive relations with peers and teachers (Miller, Gouley, Seifer, Dickstein, & Shields, 2004). Further, preschoolers with such skills evidence greater social competence in kindergarten (Denham et al., 2003), as well as greater behavioral self-regulation skills and achievement (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003), suggesting that effective regulatory skills are central to children's mastery of difficult tasks such as those associated with literacy learning.

Although the majority of research on self-regulation focuses on preschoolers and school-age children, there is evidence that the capacity for "effortful control," a temperamentally based ability to inhibit a dominant response and activate a subdominant response (Rothbart, Ellis, Rueda, & Posner, 2003), becomes increasingly coherent and consistent by age 2 (Kochanska, Coy, & Murray, 2001; Kochanska et al., 1996). In young children, effortful control has been shown to be associated with more regulated emotions and stronger restraint (Kochanska, Murray & Harlan, 2000), and poor effortful control with behavior problems (Murray & Kochanska, 2002; Rothbart et al., 2003). This self-regulation system is partially determined by biologically based control mechanisms, but considerable individual variability also is likely linked to cognitive, speech, and representational abilities. It is intriguing that coherence in an individual's ability to exert effortful control begins to be seen at an age when language abilities are blossoming. Two recent studies provide direct evidence for a link between the development of language and this aspect of self-regulation. In a twin study, Dionne et al. (2003) found evidence of heritability effects on toddlers' aggressive behaviors but not on expressive vocabulary and, most important, moderately strong negative effects of acquisition of expressive vocabulary on aggression. And in a longitudinal study of kindergartners, Hooper, Roberts, Zeisel, and Poe (2003) found that expressive and receptive language deficits predicted conduct problems with increasing accuracy as children moved from kindergarten to third grade, particularly for receptive language. These findings provide evidence of early positive impact of language-related abilities on behavioral self-regulation.

Once children enter school, self-regulation, social, and language skills all play a role in helping to shape their ability to form positive relationships with teachers and peers and to succeed in school. Effective regulatory skills help reduce the incidence of problem behaviors (Cole, Teti, & Zahn-Waxler, 2003; Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996; Eisenberg et al., 1996; Eisenberg et al., 1995), and are directly associated with positive social and academic functioning. We have shown that poor self-regulatory abilities explain the greater relationship difficulties with peers and teachers experienced by children from low-SES families (Miech, Essex & Goldsmith, 2001). And other studies have shown that children with strong regulatory skills are more capable of managing interactions that are emotionally charged (Fabes et al., 1999). In a series of studies, Ladd and colleagues have shown that kindergartners who relate to others in a positive manner, avoiding negative or aggressive actions, have more positive relationships with their teachers (Birch & Ladd, 1998) and peers, which, in turn, result in more productive engagement in school and higher levels of school achievement (Ladd, Birch, & Buhs, 1999). In another series of studies, Eisenberg and colleagues have shown that self-regulation predicts later peer popularity and socially appropriate behavior and that these associations are stronger for those children high in negative emotionality, for whom regulation is particularly important (Eisenberg, Fabes, Guthrie, & Reiser, 2000). In contrast, when children enter school with poor self-regulatory skills and aggressive behaviors that are maintained through the early school years, they experience early-emerging and sustained difficulties in their relations with both peers and teachers (Ladd et al., 1999).

The early teacher–child relationship has been shown to be especially important for children's social and academic adjustment (Pianta, 1999; Pianta, Steinberg, & Rollins, 1995), especially for children who enter school with poor self-regulatory skills (Meehan, Hughes, & Cavell, 2003). As stated by a group of highly respected de-

velopmentalists, "Children grow and thrive in the context of dependable relationships that provide love and nurturance, security, and responsive interaction, and encouragement for exploration" (Shonkoff & Phillips, 2000, p. 7), and such relationships with teachers can be particularly beneficial in forming a child's self-regulation capacities and for supporting the acquisition of knowledge and academic competencies (Birch & Ladd, 1998; Pianta, 1999). Studies have shown that teachers are more favorably disposed toward children who exhibit positive and cooperative behavior (Pallas, Entwisle, & Cadigan, 1987) and appropriate regulation of emotions (Alexander & Entwistle, 1988). Children also are more likely to be responded to favorably by teachers if they are not highly distractible and exhibit only moderate levels of emotional intensity (Keogh, 2003). Thus children who are able to regulate their emotions and attention and are socially competent benefit because they are more likely to form close ties to teachers, and they display better adjustment and more learning in school (Hamre & Pianta, 2001). Importantly, differences in the quality of these early relationships with kindergarten teachers have long-lasting effects, with indirect effects from kindergarten still apparent in eighth grade (Hamre & Pianta, 2001; Pianta, Hamre, & Stuhlman, 2002).

The importance of acquiring the language-use skills linked to social development is also revealed by children who fail to develop needed skills. Children with difficulties in using social language have been found to have problems forming and maintaining healthy peer relations because they tend to have poor social interaction skills and are more likely to be rejected by their peers (Fujiki & Brinton, 1994; Gertner, Rice, & Hadley, 1994). Recent research suggests that self-regulation may be a key factor in this process (Fujiki, Brinton, & Clarke, 2002). Other research has shown that school-age children who are aggressive demonstrate poorer communication clarity and increased disruptive communication during cooperative communication tasks than do their nonaggressive peers (Dumas, Blechman, & Prinz, 1994). And in a longitudinal study, we have recently shown that children who are stably aggressive across the elementary school years evidenced poorer self-regulatory skills and poorer receptive language abilities as preschoolers (Park et al., in press). More generally, researchers studying child mental health have found that externalizing problems and disorders, which are defined by poor social and self-regulatory skills, both accompany and are predicted by language-related impairments, including speech and language problems (Hinshaw, 2002), reading disability (McGee, Share, Moffitt, Williams, & Silva, 1998), and neurocognitive problems (Moffitt & Caspi, 2001), such as difficulties in language processing (Hinshaw, Carte, Sami, Treuting, & Zupan, 2002).

Evidence from Studies of Brain Development

The interconnected nature of development has been further reinforced by the increasing recognition in the past decade of the plasticity of the brain and the reciprocal influences of neurobiological mechanisms and child development and behavior (Nelson & Bloom, 1997; P. R. Huttenlocher, 2002). Studies in affective neuroscience have shown that the same part of the brain is critical to the neural implementation of emotion and cognition (Davidson, Scherer, & Goldsmith, 2003). And, most relevant to this chapter, the linkage of brain functioning to early school success has been outlined by Blair (2002), who proposed a developmental neurobiological model of children's school readiness that links emotionality to academic and social competence in school settings.

Linking Emotions and Higher Cognitive Functions

Studies of neural functioning have revealed that prefrontal cortical areas of the brain that support higher cognitive functioning such as memory and attention are connected to subcortical areas such as the amygdala that play an important role in emotion. Blair (2002) reviewed studies of behaviorally inhibited children (i.e., shy, very reserved, fearful) that found that they have a low threshold for limbic arousal, which results in negative emotional expression and activation of the

sympathetic nervous system. The behavioral expression of these events is behavioral inhibition, or withdrawal from stimulation. The neural systems governing arousal have also been linked to stress exposure, as revealed by increased cortisol levels that indicate activation of the hypothalamic–pituitary–adrenal (HPA) axis. Recently, we have shown that early exposure to family adversities is associated with increased cortisol levels by preschool, making young children more vulnerable to the development of socioemotional problems when facing the cognitive and social challenges of preschool and the early elementary years (Essex, Klein, Cho, & Kalin, 2002; Smider et al., 2002). Other researchers have also found that dysregulation of the HPA axis is associated with socioemotional difficulties during the preschool and early school years (Gunnar et al., 1997; Schmidt, Fox, Rubin, & Sternberg, 1997; Schmidt, Fox, Sternberg, Gold, Smith, & Schulkin, 1999) that may persist through middle childhood (Granger, Stansbury, & Henker, 1994). Further, although such family adversities are risk factors for all children, they are more prevalent in low-income families. Thus children from low-SES families have higher cortisol levels than children from higher SES families (Essex, Klein, et al., 2002; Lupien, King, Meaney, & McEwen, 2000), with more negative consequences not only for socioemotional functioning (Essex, Boyd, et al., 2002) but also for cognitive functioning (Lupien, King, Meaney & McEwen, 2001).

Together, this research suggests that the development of the affective–cognitive–linguistic systems that children draw on as they interact with peers and teachers and engage in tasks that provide opportunities to learn to use print have their roots in a complex matrix of biologically determined sensitivity to and ways of responding to stimuli and to stress-inducing experiences in the home or in classrooms. In the preschool years children first begin to acquire the ability to regulate their emotions and acquire the social skills for interacting with others. The fact that longitudinal studies find early experiences to predict later functioning suggests that preschool-age children are acquiring patterns for coping with their own emotions, integrated in routine ways of responding to life circumstances. Such patterns of response to social circumstances and to their own affective states may have long-lasting implications for children's social functioning and learning. Furthermore, there is also growing evidence that such patterns of responding and engaging in interactions have an impact on brain development.

Neural Development

Considerable effort is now going into understanding the functioning and development of the brain using varied sophisticated methods. Pugh, Sandak, Frost, Moore, and Mencl (Chapter 5, this volume) review one line of research that is beginning to reveal the connections between activation of selected areas of the brain and reading and reading disability. Interestingly, this work is showing the impact of children's activity on the functioning of the brain, as indicated by the fact that an effective reading intervention results both in improved reading performance and in changed patterns of neural activity. Such work is consistent with the emerging consensus that, for higher cognitive functions such as reasoning, planning, remembering, and reading comprehension, the brain has considerable plasticity (reviewed by Blair, 2002; P. R. Huttenlocher, 2002). For example, P. R. Huttenlocher (2002) notes that the left angular gyrus, an area implicated in reading that abuts Wernicke's area (an area involved in comprehending language), may support language processing in the preschool years and then shifts to support reading. He speculates that language, like other neural functions, may initially be relatively diffusely represented and that as language skills are routinized they may become restricted to particular language areas and the angular gyrus recruited to support reading. Such a shift is one example of neural plasticity and the complex interplay between genetically determined pathways of brain development and experiences that shape development of the brain in a multitude of ways (Black, 2003).

One approach to neural development, known as the *selectionist approach* to developing connectivity in the brain, argues that genetically determined development results in an early overproduction of possible synaptic connections and that these connections are pruned, with certain connections preserved and strengthened whereas others are

eliminated (reviewed by P. R. Huttenlocher, 2002). Synaptic connections that are active are maintained and strengthened as they consume available resources (glucose, oxygen) and are organized into interconnected sets of synapses. There is a general timetable for this overproduction and subsequent pruning, but P. R. Huttenlocher (2002) argues that there is not a "critical" period during which experience shapes brain development. Instead, there seem to be "windows of opportunity," which are "periods in brain development during which the effects of environmental stimulation on brain structure and function are maximal" (p. 207). It is during these periods that teaching and enrichment programs are likely to have maximal impact. He concludes that it is between late infancy and late childhood that synaptic density reaches a plateau and that this is the point of maximal responsiveness to environmental input (p. 209). This relatively wide window of opportunity suggests that the preschool years occur at a relatively early point of maximal plasticity. Significantly, it is during this period that synaptic density in three areas that support language functioning—Broca's area, Wernicke's area, and Heschl's gyrus—reach their peak levels of synaptic density. Density subsequently declines until about age 10, when it then levels off (P. R. Huttenlocher, 2002, p. 50). Measures of metabolism of glucose, a measure of neural activity, also reach high levels around age 3 and then decline gradually until about age 10 (P. R. Huttenlocher, 2002, p. 70).

A second approach to considering neural development is the *constructivist approach*, which argues for a potentially larger role for experience in the organization and specification of functioning of the brain, particularly of the neocortex, which supports higher cognitive functions (Quartz & Sejnowski, 1997). According to this theory, early in life relatively little of the cerebral cortex is dedicated to specific functions. Subsequent interaction of neural activity that is responsive to experience and neural growth mechanisms affect the representational properties of the cortex and help shape neural organization. According to this view, plasticity is also evident in the processes by which varied areas of the brain are connected. Reviewing studies of electroencephalographic (EEG) activity, Blair (2002) highlighted evidence indicating the establishment of connections between frontal lobes and sensory areas, which provides a neural basis for understanding the emergence of the executive functions that are important for self-regulation and for higher cognitive activity.

Summary of Theoretical Accounts of Development

A full accounting of the emergence of literacy and of long-term literacy ability requires charting the emergence and interrelationships among multiple linguistic–cognitive–affective systems that are recruited to support this complex and socially valued set of abilities. Language skills are central to initial literacy and to long-term literacy development, and evidence is accumulating that language also plays an important role in development of social and emotional competence. Children who are able to control their own attention and engage in school in positive ways are more likely to have interactions with peers and to form positive relationships with teachers. These relationships have a positive impact on subsequent educational success. Converging lines of research in neural development suggest that experience plays an important role in the organization of the brain, including the interconnectivity between areas that support higher cognitive functioning and regions linked to emotionality. Other work suggests that the preschool years may be a time when a "window of opportunity" opens for experience to have a significant impact on neural development. Finally, we posit that language plays a pivotal role in the orchestration of connections that support literacy and regulation of emotions and emergence of social competence.

The Need for High-Quality Language Support in Preschools

Converging research from different areas of development makes evident the importance of language. Studies of the impact of preschool classrooms on language and cognitive development demonstrate the fact that these are settings that can play an important role in fostering language growth (see also Farran, Aydogan, Kang, & Lipsey, Chapter 19, this

volume). Development in preschool is best predicted by varied measures of the quality of teacher–child interaction (Dickinson & Tabors, 2001; McCartney, 1984), yet the more carefully we look at preschool discourse the more we see need for improvement. A number of studies of the language environments of preschool classrooms reveal low levels of interaction. Tizard and Hughes (1985) examined British infant schools and found far fewer extended, intellectually engaging conversations between teachers and children in classrooms than between parents and those same children at home. In the early 1990s in the United States, Layzer, Goodson, and Moss (1993) did intensive week-long observations in 119 classrooms and found teachers talking with individuals or small groups only 26% of the time, less time than they spent not talking with any children (28%). For 20% of the classrooms visited for a week, half or more of the children never had individual attention from a teacher. Preschools associated with universities also have been found to be places of limited teacher–child interaction, as one study conducted in laboratory classrooms found that, when teachers were in close proximity to children (3 feet or less), they usually (81% of the time) did not speak to the children to whom they were near (Kontos & Wilcox-Herzog, 1997).

Recently we studied 77 Head Start classrooms, in which we observed teachers during choice time—the period of the day when children select activities on their own—and meal times (Dickinson, McCabe, & Clark-Chiarelli, 2004) and coded them using a time-sampling system that described the kinds of interactions found to be supportive of development (Dickinson & McCabe, 2001; Dickinson & Smith, 1994). We observed teachers for 8 to 12 intervals of 30 seconds each and found that teachers engaged in instructional talk (talk about language, ideas, print, numbers) only 12% of the time. The teachers who were at the high end of the continuum, the 75th percentile, in use of such talk engaged in instructional talk only 18% of the time. Teachers were able to establish and deepen a topic in only 14% of these intervals, and explicit talk about words was almost absent, being found in fewer than 1% of the intervals. No such interactions were observed at all in 89% of the rooms.

For the Home–School Study of Language and Literacy Development (HSSLLD), we audiotaped teachers and children throughout the day and analyzed interactions in detail. We audiotaped 75 4-year-old children during the day for a total of 6,640 minutes and found that, during choice time, children were silent 59% of the time. They interacted with teachers 17% of the time and with other children 18% of the time (Dickinson, 2001a). Given the results reported here, it seems that those occasions on which children did converse with teachers were rich with educational potential. Although variation in quality clearly had significant effects on children, on average the conversations were far from ideal. We recorded, transcribed, and analyzed 15 minutes of free-play conversation between teachers and children. The measure of language use that was the most predictive of later language development was the percentage of total words used that were "rare" words, defined as words not included on a list of 7,881 words identified by Chall and Dale (1995) as common for third-grade children. We found that these 15 minutes of conversational time included 287 different words, only 14 of which were "rare" words; these 14 uses of such words represented only 9 different word types (Dickinson, 2001a; Dickinson & Tabors, 2001). Given that teachers were interacting with children during a variety of activities with the potential for conversation about a host of interesting topics (e.g., *excavating tunnels* in the sand, noting *evaporation* of water from paint or sand, *constructing skyscrapers* in the blocks area), this reflects a very low rate of use of varied words and suggests that shortcomings result from teachers' conversational habits rather than that they have nothing to talk about.

During book reading, another setting found to relate to later vocabulary development (Dickinson & McCabe, 2003; Dickinson & Smith, 1994), we found that the texts of books yielded 10.6 total rare words and 7.1 different types of words, whereas teachers' conversations about books included only 4.7 rare words and 2.8 different words (Dickinson, McCabe, & Anastasopoulos, 2002). The low density of rare words in teachers' discourse clearly reveals that teachers rarely intentionally use or discuss the interesting words found in books. The limita-

tions in the amount and quality of teacher–child discourse, especially the limited use of rare vocabulary, suggest that teachers typically provide children minimal individualized support for development of language and literacy. Such patterns of interaction highlight shortcomings in support for language and literacy and the paucity of content knowledge instruction. They also suggest that teachers provide little intentional support for children's understanding of the complexities of social interaction, because such interactions necessarily would probe issues such as motivations and intentions, topics that typically result in extended, cognitively rich interactions (Tizard & Hughes, 1985). The pervasiveness and consistency of these findings clearly suggest that there are powerful, systematic forces at work that act to constrain patterns of teacher–child interaction.

Providing Classroom Support for Language, Literacy, and Knowledge

A number of avenues may be pursued in order to bring about changes in the patterns of interaction in preschool classrooms that are of sufficient magnitude to result in substantial improvements in children's achievement. Given space constraints, we touch on a few of the most noteworthy approaches, concluding with a brief discussion of the role of curriculum. We highlight ways in which these efforts may support improved patterns of language use, but we realize that each factor discussed can have multiple effects on teachers and classroom functioning.

Structural Initiatives

Two key regulated features of classrooms are teacher–child ratio and teachers' educational levels. Both higher ratios and higher educational attainment have repeatedly been found to result in better outcomes for children (reviewed in Shonkoff & Phillips, 2000). The ratio of teachers to children has repeatedly been found to result in better outcomes for children most likely, in part, because having fewer children increases the opportunities teachers have to converse with individuals. The positive association between teachers' educational levels and child outcomes also may reflect differences in patterns of language use because teachers with more schooling may have language-based advantages over their less well-educated colleagues. In addition to learning pedagogical methods, as teachers complete college courses they are exposed to and likely acquire new vocabulary and associated world knowledge, and they may gain comfort in reading and talking about books.

Professional Development

Considerable effort and large sums are spent on professional development, but few literacy-focused initiatives have been researched. We have carried out one such line of work (Dickinson, Miller, & Anastasopoulos, 2001a; Dickinson, Anastasopoulos, Miller, Caswell, & Peisner-Feinberg, 2002; Dickinson & Brady, 2005). Our approach has been to use inservice credit-bearing courses to deepen teachers' knowledge of early literacy development. The courses involve readings, videotapes that depict effective classroom practices, and assignments that require teachers to implement new strategies and that guide teachers to reflect on children's learning. These courses have been delivered in face-to-face sessions and by using interactive video conferencing. Comparison group studies have found substantial changes in classroom practices, as well as strong evidence of effects on vocabulary and phonological sensitivity (Dickinson et al., 2002; Dickinson, Sprague, Sayer, Miller, & Clark, 2001).

Other research teams have sought to bolster children's learning by striving to improve the quality of conversations during book reading. Whitehurst's groundbreaking dialogic reading demonstrated that a book-focused intervention can translate into enhanced learning when employed by parents and teachers (Arnold & Whitehurst, 1994). Subsequently, other teams have adopted other approaches to improving book reading in classrooms. Beck and McKeown (see Chapter 21, this volume) developed strategies for helping teachers engage in book discussions that draw children into focused and deep conversations about books. Similarly, Wasik and Bond (2001) devised an intensive intervention that includes in-class modeling that alters practices and improves children's learning. However, limited generalization of conversational strategies was found. These

efforts to improve teacher–child interaction during book reading highlight the difficulty we face as we attempt to substantially alter how teachers converse with children. Wasik's difficulty in altering practice in multiple settings is particularly sobering because book reading may be the most well-defined context of the typical preschool day, yet it accounts for only a small portion of the day and does not allow for the kind of individually tailored conversations found to have substantial impact on children's language acquisition (Dickinson, 2001b).

Curriculum

Recently there has been growing awareness that curriculum plays an important role in provision of educationally rich classrooms. Head Start now requires that all programs use some curriculum. Data collected on a representative sample of Head Start classrooms indicates that curriculum choice does make a difference in children's learning (see Zill & Resnick, Chapter 26, this volume). Ongoing federally funded studies will soon begin to provide solid empirical data on the relative effectiveness of these and other early childhood curricula.

Recognizing the need of preschool teachers for considerable support in providing intellectually challenging and linguistically rich conversations, Schickedanz and Dickinson (2005) recently developed a curriculum that provides comprehensive full-day programming. It was designed to support all aspects of development, including skills such as self-regulation and social development. Built around a collection of high-quality children's books, teachers develop thematic units that include content-rich hands-on activities. Key vocabulary is identified, and teachers are given guidance in using these words during book reading and throughout the day, and tips for observing and conversing with children are provided in an effort to encourage teachers to engage in effective interactions throughout the day. Game-like activities target phonemic awareness and print knowledge, and group discussions address socioemotional topics.

Results from pilot studies conducted in programs serving low-income families in Washington, D.C., and Springfield, Massachusetts, are encouraging. For example, in Washington, D.C., where the curriculum was employed for a full academic year, PPVT data were collected from 17 children in the fall, winter, and spring. Average gains of 13.5 points were found, reflecting overall improvement from 89.4 to 102.5. For the eight children who entered with lowest fall scores, average gains of 18.6 points were found. In Springfield, a larger initiative, a partial implementation of the curriculum was carried out. Early data were collected with about a 2-month interval between pre- and posttesting. For the 53 children tested at both times, children's performance on the Preschool Language Survey Receptive Language scale improved from 94 to 102, an increase of one-half standard deviation. A parallel qualitative study carried out in Boston examined patterns of book reading before, during, and at the end of the use of two units of the curriculum. Dramatic increases in the amount of talk about the meanings of words and analytic discussion of the stories were found, with these changes reflecting teachers' use of the guidance provided by the curriculum. These hopeful early findings suggest that strong preschool curricula may substantially boost children's achievement, especially when combined with strong professional development.

Policy

A rapid paradigm shift has been occurring at the highest levels of the early childhood world. In the 1980s policies and statements issued by the leading early childhood organization, the National Association for the Education of Young Children (NAEYC), reflected considerable distrust of literacy (Dickinson, 2002), but by the late 1990s NAEYC released a joint position statement with the International Reading Association that drew on the most current research on literacy development (International Reading Association & National Association for the Education of Young Children, 1998). Further, the new accreditation standards call for considerably enhanced quality with respect to literacy and content learning more generally. Such significant changes in policy cannot help but elevate the value accorded instructional practices that support literacy and content instruction.

Concluding Thoughts

Over the past 30 years we have come to clear recognition of the serious gap in educational achievement between the haves and have-nots of society and are increasingly recognizing the early genesis of this gap. Vigorous research has brought increasing insight into complex pathways of different aspects of development; in the coming decades we are likely to arrive at a far better understanding of the complex intertwined nature of development, especially as we investigate the interactions among different domains. When literacy is viewed as the organization of complex interacting systems, it becomes clear that we need research and theories that consider changes in the interdependencies among domains and efforts to understand the malleability of different aspects at different points of development. Given what we now know, it appears that the later preschool years are one period during which the window to the development of language-related competencies is wide open. Biological findings combine with psychological research to provide social policy with abundant evidence about the sensitivity of preschool-age children to intervention. We need to seize the opportunity to intervene in the lives of children from families that are in need of significant assistance from the educational systems in nourishing their children's language and intellectual development.

Unfortunately, powerful forces have created and continue to sustain an early childhood educational system that is falling short of providing the kind of support children from low-income backgrounds require. We briefly sketched some of the efforts being made to turn the tide in favor of children at risk of educational failure. Although it is important to note hopeful directions, we must temper optimism with caution born of recognition of the array of factors that some families must confront. Too many parents are either unemployed or underemployed, with the result being limited income and stress that contributes to depression that can undermine the type of responsive parenting shown to be critical to establishing strong early bonds (see Landry & Smith, Chapter 10, and Pianta, Chapter 11, this volume). Parents in the types of jobs available to adults with limited incomes may lack the kind of job-related stimulation that seems to enrich household interactions (Leseman & van Tuijl, Chapter 16, this volume). Furthermore, families with limited incomes must live in communities in which access to print and support for learning are limited (Neuman, Chapter 2, and Britto, Fuligni, & Brooks-Gunn, Chapter 23, this volume). The community child care that such families find near them is likely to be staffed by teachers drawn from the community who have limited education and a history of limited access to the type of wide-ranging knowledge about the world that the children they serve need (Neuman, Chapter 2, this volume). These programs may be barely managing to make ends meet and, as a result, may have few books and other supplies to support learning, no funds for professional development, and little ability to allow teachers release time to attend workshops or take courses.

The challenges some families face as they seek to prepare their children for success in school are truly daunting. Our society is slowly beginning to recognize the costs it pays for failing to adequately respond to the needs of such families. On our side is the fact that we typically organize preschools and kindergarten in a fashion that allows for the kind of individualized one-to-one and small-group adult–child interactions that have great potential for nourishing language and intellectual development. In such settings, children have the potential to make remarkable progress if they are taught by energetic and sensitive teachers who understand language, as well as cognitive and emotional, development. We are making hopeful advances in our endeavor to enrich the preschool experiences of children, but far more must be done to improve their classrooms and communities if we are to take full advantage of the window of educational opportunity provided us by biology.

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