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Translational research on early language development: Current challenges and future directions

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Abstract

There is a pressing need for the early and accurate identification of young children at risk for language and other developmental disabilities and the provision of timely, age-appropriate intervention, as mandated by Part C of the Individuals with Disabilities Education Act. Research has shown that early intervention is effective for many language impaired children in different etiological groups, and can reduce the functional impact of persistent disorders on children and their families. Yet, the accurate identification of infants and toddlers at risk for language impairment remains elusive, especially for late-talking children without obvious genetic or neurological conditions. In this paper, the need for translational research on basic processes in early language development in typical and atypical populations and the contextual factors that affect them are discussed, along with current challenges and future directions for its successful implementation. Implications of this research for clinical evidence-based practice are also considered.

Of the 12–16% of American children with neurodevelopmental or behavioral disorders (American Academy of Pediatrics Committee on Children with Disabilities, 2001), a majority has delayed or deviant language (Feldman, 2005; Grizzle & Simms, 2005). This is especially the case when disorders result from genetic or chromosomal abnormalities such as Down syndrome (Abbeduto & Murphy, 2004; Chapman & Hesketh, 2001), fragile X syndrome (Abbeduto & Hagerman, 1997; Dykens, Hodapp, & Finucane, 2000), or Williams syndrome (Bellugi, Wang, & Jernigan, 1994; Karmiloff-Smith & Thomas, 2003), or from complex syndromes such the autism spectrum disorders (Happe & Frith, 1996; Lord & Paul, 1997). Although these disorders are fairly rare, prevalence estimates for preschool-aged children with language impairment with no known genetic etiology and normal nonverbal intelligence (e.g., specific language impairment) are substantially higher, ranging between 2 and 8% (median 5.95%; Feldman, 2005). A sizable percentage of late-talking preschoolers with normal nonverbal intelligence will continue to manifest language problems in later childhood (Grizzle & Simms, 2005; Paul, 1996), augmenting clinical concerns for this group of children.

Given that language and speech problems are associated with academic, socioemotional, and psychiatric problems (Catts, 1993; Cohen, Davine, Horodezky, Lipsett, & Isaacson, 1993; Rice, Hadley, & Alexander, 1993), there is a pressing need for early and accurate identification of young children with emergent language problems and the provision of age-appropriate intervention. Moreover, Part C of the Individuals with Disabilities Education Act mandates the early identification and pro-

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vision of intervention for infants and toddlers with developmental disabilities (birth to age 2) through the development of community-based systems. Studies have shown that early intervention is effective for many language impaired children in different etiological groups (Guralnick, 1997; Leonard, 1998; Ramey, Campbell, & Ramey, 1999), and can reduce the functional impact of persistent disorders on children and their families. Improvements in sociocommunicative skills are especially well documented.

Unfortunately, accurate detection of true developmental delays or deviations in early childhood remains elusive, especially for late-talking children without obvious genetic or neurological conditions (Dale, Price, Bishop, & Plomin, 2003). This is likely due to the wide range of normal variability in the early stages of typical language development (Bates, Bretherton, & Snyder, 1988; Fenson et al., 1994; Goldfield & Snow, 2005; Shore, 1995) and the fact that many toddlers with delayed language development and normal cognitive and motor development function within normal limits on language assessments by school age (Leonard, 1998; Rescorla, 2002). Moreover, children's early language development in both typical and atypical populations is a dynamic process that is affected by a complex array of transacting factors from multiple levels of influence, such as genetics, gender, temperament, the child's own skills in other developmental domains (cognitive, motor, socioemotional), and a host of biological and social risk and resilience factors, for example, premature birth, prenatal exposure to substances, parental education, caregiver interactive style, parent–child mutual regulation, bilingualism, and other cultural influences (Bates, 2003; Bates, Bretherton, Beeghly, & McNew, 1982; Beeghly, 1997; Beeghly & Cicchetti, 1994; Cicchetti, 1984; Elman et al., 1996; Landry, Smith, Miller-Loncar, & Swank, 1997; Luthar, Cicchetti, & Becker, 2000; Sameroff & Fiese, 1990; Spiker, Boyce, & Boyce, 2002; Thorpe, Rutter, & Greenwood, 2003). This complexity has made it difficult for clinicians to pinpoint the exact nature of the presenting problem and to make unequivocal diagnoses of clinically significant language impairments, especially when children are younger than 3 or 4 years of age (Leonard, 1998; Thal & Katich, 1996; Thal, Reilly, Seibert, Jeffries, & Fenson, 2004).

Need for Translational Research on Early Language Development

Thus, there is a pressing clinical need for accurate, detailed information on multiple aspects of early typical and atypical language functioning and the diverse cognitive, behavioral, and contextual factors that affect them. In response, the NIH has recently called for collaborative translational ("bench to bedside") research on basic developmental processes in both typical and atypical populations to better inform and guide clinical practice with children with developmental disorders, including language impairment, and to encourage basic behavioral scientists to seek a further understanding of how behavioral processes (such as language) are altered by developmental disorders. Until recently, however, advancement in collaborative translational language research has been hampered by fragmentation among multidisciplinary fields, related funding constraints, and poor communication among investigators from different disciplines (McCardle, Cooper, & Freund, 2005; Nelson et al., 2002; Rice & Warren, 2005b).

Most extant research on early language acquisition in children with language disorders has focused on a narrow range of language behaviors (e.g., vocabulary or morphosyntax) within one specific clinical group (e.g., Down syndrome, autism, or specific language impairment), describing single deficits relative to various control groups or evaluating within-group profiles of specific linguistic and cognitive skills within a particular group (Rice & Warren, 2005a; Rice, Warren, & Betz, 2005). Despite this limited focus, this research has provided a wealth of valuable information about the nature and process of those particular aspects of language development in specific populations. Results of profile analyses within different populations have been especially helpful in debunking stereotypes about different etiologic groups and have highlighted methodological caveats for future re-

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search, including the need for longitudinal research and the continued need to evaluate multiple dimensions of language (e.g., vocabulary/semantics, grammar/syntax, and pragmatics) in diverse groups. This research has also fueled and sparked continuing debates among researchers regarding the age-old philosophical question of the ontogenetic association between language and cognition (e.g., Elman et al., 1996; Karmiloff-Smith & Thomas, 2003; Thelen & Bates, 2003).

For illustrative purposes, a brief summary of some of the key research findings for four clinical groups of children with delayed or disordered language development that have been investigated intensively (Down syndrome, autism spectrum disorders, Williams syndrome, and specific language impairment) is provided here. This summary is not meant to be exhaustive.

Down syndrome

With a prevalence of approximately 1 in 700 to 1,000, Down syndrome is the most common genetic cause of mental retardation (Rozien, 1997). Children with Down syndrome have been of particular interest to language development researchers because Down syndrome is etiologically distinct and can be identified and studied very early in life. As is true for children with other genetic disorders, children with Down syndrome manifest a unique profile of linguistic, cognitive, affective-motivational, and social abilities in early childhood. Although developmentally delayed, children with Down syndrome vary in the level of their general cognitive functioning from severely retarded to nearly normal (Chapman & Hesketh, 2001). Their delayed yet variable development allows for a more precise examination of the sequences of various aspects of their language and nonverbal development than is possible with typical children with more rapid development (Cicchetti & Beeghly, 1990).

Evidence for both delayed and deviant aspects of early language and nonverbal cognitive development has been reported for children with Down syndrome (Abbeduto & Murphy, 2004; Beeghly, Weiss-Perry, & Cicchetti, 1990; Chapman & Hesketh, 2001; Fowler, 1990; Miller, 1990). With increasing age, young children with Down syndrome exhibit increasing linguistic deficits in relation to their nonverbal cognitive abilities (Chapman, 2003; Chapman & Hesketh, 2001), including pretend play (Beeghly, 1997; Beeghly, Perry, & Cicchetti, 1989; Cielinski, Vaughn, Seifer, & Contreras, 1995). However, production delays tend to exceed comprehension delays, and syntactic skills are more severely compromised than lexical or pragmatic abilities (Beeghly et al., 1990; Fowler, 1990; Miller, 1990). Fowler (1990) has reported that many children with Down syndrome do not progress beyond the early stages of morphological and syntactic development. Strengths and weaknesses have also been reported for cognitive skills associated with language functioning. For instance, children with Down syndrome exhibit deficits in auditory short-term memory relative to visual short-term memory and other cognitive skills (Chapman, 2003).

Of note, specific results for particular domains of functioning within language often vary among studies, depending on the age of the children being evaluated and the specific assessment contexts and dependent measures used. For instance, in an observational study of children with Down syndrome interacting with their mothers during semistructured and unstructured play contexts, children with Down syndrome exhibited pragmatic skills (diversity of speech acts, turn taking skills, connected discourse) that were consistent with their general cognitive abilities (Beeghly & Cicchetti, 1997). In contrast, in an experimental study using a variety of elicitation prompts and dependent measures, children with Down syndrome exhibited both strengths and weaknesses in pragmatic skills (Abbeduto & Murphy, 2004), raising methodological caveats for future studies.

Autism and pervasive developmental disorders

Despite the relatively low incidence of autism (approximately 4–10 cases in every 10,000 live births; Happe, 1995), the early language and cognitive development of children with autism and related disorders has

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been intensively studied during the past 2 decades (see reviews by Baron-Cohen, 1995; Cicchetti, Beeghly, & Weiss-Perry, 1994; Lord & Paul, 1997; Mundy, Sigman, & Kasari, 1990; Sigman, 1994). Children with autism exhibit a triad of severe impairments, including language/communicative deficits, social cognitive (theory of mind) difficulties, and social behavioral differences (American Psychiatric Association, 1994), as well as wide individual differences in functioning (Dawson & Castelloe, 1992; Lord, Risi, & Pickles, 2004).

In prior reviews, investigators estimated that approximately half of children with autism were nonverbal (see Lord & Rutter, 1994). However, this estimate appears to be changing, perhaps due to the broader diagnostic criteria currently used for autism and the increasing prevalence of autistic disorders (Newschaffer, Falb, & Gurney, 2005). For instance, in a recent analysis using combined data from several different studies, Lord and colleagues (Lord et al., 2004) estimated that, by age 9, 14–20% of children with autism had no consistent words, 10–14% had "words but not three-word phrases," 23–35% had "phrases but not fluent," and 41–43% had fluent language.

Delays and differences in particular aspects of language have been reported for children with autistic spectrum disorders. Generally speaking, pragmatic skills (e.g., discourse processes, communicating intended meaning to others) are more severely compromised than lexical or syntactic skills (Lord & Paul, 1997), but delays in the latter aspects of language are also present. Tager-Flusberg (2004a) has recently hypothesized that there may be a subgroup of children with autism who exhibit deficits in morphosyntactic skills that are similar to those observed in children with specific language impairment (Tager-Flusberg, 2004a). In addition to language deficits, many children with autism exhibit comorbid difficulties in working memory and executive functions such as planning, sequencing, and set shifting, which could interfere with their language and sociocommunicative performance (Happe & Frith, 1996; Joseph, 1999).

Although less well studied, an uneven profile of emergent language and nonverbal communicative skills has also been reported for young children with autism spectrum disorder. In a study of toddlers and preschoolers with autism spectrum disorder using the MacArthur Communicative Development Inventory—Infant Form (CDI; Charman, Drew, Baird, & Baird, 2003), children with autism exhibited significant delays in language and gestural communication, relative to typically developing children. However, word comprehension was delayed relative to word production, and the production of early gestures involving shared reference was delayed relative to the production of late gestures involving actions with objects. Considerable variability in language acquisition was also observed, which is consistent with the typical pattern (Fenson et al., 1994).

Others have reported that young children with autism consistently have impairments on early nonverbal symbolic skills that are thought to be precursors and correlates of later language development and theory of mind, that is, joint attention skills, imitation, and pretend play (Baron-Cohen, 1987; Charman, 1997; Charman et al., 2000; Mundy, Sigman, & Kasari, 1994; Phillips, Baron-Cohen, & Rutter, 1992; Roeyers, VanOost, & Bothuyne, 1998; Yirmiya, Pilowsky, Solomonica-Levy, & Shulman, 1999). For instance, in a study of nonverbal communication in young children with autism and children with developmental delays or language impairments using a battery of structured communication tasks (Stone, Ousley, Yoder, Hogan, & Hepburn, 1997), children with autism requested more often but commented less often than the comparison children. Consistent with other research (Mundy, Sigman, & Kasari, 1993), children with autism were less likely to point, show objects, or use eye gaze to communicate, but were more likely to directly manipulate the experimenter's hand. The autistic group also used less complex combinations of behaviors to communicate. Of note, other research has shown that these nonverbal communicative differences cannot be explained solely by the presence of motor deficits, attention problems, or low sociability (Phillips et al., 1992).

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Williams syndrome

Williams syndrome is a rare genetic disorder (incidence between 1/10,000 and 1/20,000 live births) that is caused by a microdeletion of about 20 genes on chromosome 7q11.23 and associated with a highly unusual neuropsychological profile (Karmiloff-Smith & Thomas, 2003; Mervis, 2003; Morris, 2004). Despite moderate mental retardation (average IQ scores range from 50 to 70), individuals with this disorder have surprisingly complex language skills (Bellugi et al., 1994; Singer, Bellugi, Bates, Jones, & Rossen, 1994) and tend to be quite affectively expressive and socially attuned (Reilly, Klima, & Bellugi, 1991). At the same time, these persons have profound deficits in their fine motor and visual–spatial cognitive functioning, which exceed the level of their general cognitive impairment (Bellugi et al., 1994). Some investigators in early studies of this disorder have claimed that the marked language/cognition dissociations observed in individuals with Williams syndrome provide strong support for a "modularity" hypothesis regarding the relationship between language and cognition in ontogeny. However, recent studies evaluating a greater variety of language and cognitive measures at diverse ages have indicated a more complex relationship (Bates, 2003; Karmiloff-Smith & Thomas, 2003; Mervis, 2003).

Evidence for both delayed and deviant aspects of language has been reported for school-aged children with Williams syndrome. For instance, Robinson, Mervis, and Robinson (2003) reported that 10-year-olds with Williams syndrome relied on their working memory to a greater extent than grammar-matched typical children during language tasks, even when differences in receptive vocabulary skills were covaried. This finding suggests a deviant pattern of language development (see also Karmiloff-Smith & Thomas, 2003). However, other research has provided evidence for a delayed pattern of language production. For instance, Zukowski (2004) reported that the errors made by children with autism when producing sentences containing relative clauses and negative questions were similar to those made by typically developing children at younger ages (Zukowski, 2004). Further research evaluating multiple aspects of language in this population is needed to resolve these apparent inconsistencies.

Although understudied, it appears that young children with Williams syndrome also exhibit delays and differences in early language acquisition, when compared to typical children or children in other clinical groups. However, specific results vary. It is generally agreed that children with Williams syndrome are delayed in the onset of their first words and first word combinations, relative to age-matched typical children. Once productive vocabulary emerges, however, toddlers with Williams syndrome have higher expressive vocabularies than age-matched toddlers with Down syndrome, as measured using the MacArthur CDI (Mervis & Robinson, 2000), a pattern consistent with their relative strengths in lexical development later in ontogeny.

A somewhat different pattern of findings was reported for young children with Williams syndrome in another cross-population comparison study using the MacArthur CDI (Singer et al., 1994). In that study, the early language and nonverbal communicative skills of children with William syndrome were compared to those of children with Down syndrome (average chronological age = 12–76 months). Consistent with other research, children in both groups were significantly delayed in the onset of first productive words, relative to typically developing children. However, when children were classified by level of expressive vocabulary (<50 vs. ≥ 50 words), differences in nonverbal communicative and grammatical skills emerged. Among children producing fewer than 50 words, children with Williams syndrome produced significantly fewer communicative and pretend gestures (e.g., intentional communicative gestures such as pointing and pretend/referential gestures such as holding a phone to the ear) than children with Down syndrome. In contrast, among children producing 50 words or more, children with Williams syndrome showed significant advances in grammatical development relative to the children with Down syndrome.

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In a series of studies on the nonverbal communicative precursors to language, Laing et al. (2002) found that preschoolers with Williams syndrome were impaired in triadic communicative processes, which have been linked with the referential uses of language in typical development (see also Mervis et al., 2003). Despite higher levels of expressive vocabulary, children with Williams syndrome also exhibited dissociations between comprehension and the production of referential pointing, which could not be explained solely by motor impairment. These findings suggest that the course of early language acquisition for children with Williams syndrome may follow an atypical pathway, which challenges prior claims that children with Williams syndrome have preserved linguistic and social skills (Laing et al., 2002).

Taken together, these findings from studies of early language development in different clinical groups raise several methodological caveats. Investigators in future cross-population studies of language acquisition in young children with language disorders should control for both level of language development and chronological age, and evaluate multiple aspects of language and nonverbal communicative behavior. Moreover, longitudinal studies of the complex, dynamic interplay between different aspects of language and nonverbal communicative skills would be especially helpful to clarify discrepant findings among studies.

Specific language impairment

By definition, children with specific language impairment perform below age expectations on standardized language measures but within normal limits on measures of nonverbal intelligence, and have no hearing loss or known genetic or neurological disorders. Thus, in contrast to the other populations described above, language impairment is the defining feature of this condition (Leonard, 1998). The prevalence of preschool-aged children with specific language impairment ranges from 2 to 8% (median 5.95%), with a higher prevalence among boys, children with a family history of language, speech, or reading disorders, children born prematurely, and children from families with low socioeconomic status (SES; Feldman, 2005; Law, Boyle, Harris, Harkness, & Nye, 2000; Tomblin, Smith, & Zhang, 1997). About a quarter to one-half of language delayed preschoolers with normal nonverbal intelligence will continue to manifest language problems in later childhood (Grizzle & Simms, 2005; Paul, 1996).

Despite much research, many questions remain concerning the causes and characteristics of specific language impairment. As is the case with other language disorders, considerable attention has been given to evaluating whether the language deficits observed in this group are delayed or deviant compared to typical children (Rice & Warren, 2005b; Wulfeck, Bates, Krupa-Kwiatkowski, & Saltzman, 2004). This research has shown that, although multiple aspects of their spoken language are delayed, relative to that observed in age peers, children with specific language impairment appear to have particular difficulty with phonological processing (measured by nonword repetition tasks; Conti-Ramsden, Botting, & Faragher, 2001) and specific morphosyntactic features of language (i.e., morphemes that denote grammatical finiteness of a sentence, such as third person singular "–s," past tense "–ed," irregular past tense forms, copula "be," and auxiliary "be" and "do"; Rice et al., 2005; Rice, Wexler, Marquis, & Hershberger, 2000). That is, children with specific language impairment perform below both age-matched and language-matched peers on these measures, suggesting a deviant pattern of these aspects of linguistic growth (Leonard, 1998; Tager-Flusberg, 2004a; Wulfeck et al., 2004). In contrast, their receptive vocabulary skills and mean length of utterance in morphemes appear to be consistent with that observed in language-matched peers, suggesting a delayed rather than deviant pattern of lexical and general syntactic development (Rice, 2004). However, other research has shown that a subset of children with specific language impairment exhibit a relatively high level of pragmatically inappropriate responses to conversational solicitations that cannot be explained by limited grammar or vocabulary (Bishop, Chan, Adams, Hartley, & Weir, 2000), indicating that specific language impairment is a heterogeneous group.

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How specific language impairment manifests during infancy and toddlerhood is unclear. When "late talkers" are followed from early to later childhood, half to three-quarters score in the normal range on language development tests (Paul, 1996; Rescorla, 2002), and the others continue to exhibit delayed expressive language development in later childhood (and often develop reading and learning problems). It is unclear what specific factors may underlie such diverse outcomes. Given that specific language impairment is associated with male gender and tends to run in families (Leonard, 1998), genetic etiological factors are likely; however, the specific genetic factors associated with this disorder have not yet been identified (Rice, 2004).

Given the heterogeneity of outcome this group, researchers and clinicians are beginning to reevaluate current diagnostic criteria in this group. For instance, a growing number of studies has reported that children in this group exhibit below-age level performance on specific nonlinguistic skills such as processing capacity and the ability to encode temporal characteristics of auditory stimuli (Bishop, 1994; Tallal, Merzenich, Miller, & Jenkins, 1998). This indicates that general omnibus measures of nonverbal intelligence may not be adequate for diagnostic purposes for these children, and suggests avenues for future research in this population (Rice, 2004).

Cross-Population Studies

Given the momentum in genetic and biobehavioral investigations within particular language disorders during the past decade, Rice and colleagues have recently heralded the need for further collaborative cross-population research to document the ways in which language disorders are manifest across clinical conditions (see Rice et al., 2005; Rice & Warren, 2004). Such research could lead to a deeper understanding of the commonalities and differences across conditions, the specific symptom profiles associated with each condition, and how general intellectual impairment with a specific genetic basis may affect the process of language acquisition in multiple domains. Cross-population comparisons would also facilitate the identification of subtypes of disability within diverse clinical conditions and enhance our ability to identify early in development young children who are likely to develop clinically significant language-learning problems (Reilly, Losh, Bellugi, & Wulfeck, 2004; Thal et al., 2004). In turn, the documentation of subtypes and the specific contextual factors associated with individual differences within conditions would augment our understanding of the different levels of risk that may predispose very young children in different groups for persistent language impairment. More generally, such research would contribute to our understanding of the nature and variability possible in human language development and would enhance our understanding of the brain bases of language and language development (Rice & Warren, 2004; Thal et al., 2004).

Although cross-population studies of language disorders are relatively rare to date, those that exist have raised some important questions and offered a few surprises. For instance, in a series of comparative studies conducted by a multidisciplinary group of collaborators in San Diego, aspects of children's language processing and acquisition were evaluated across several clinical populations at different ages. The clinical groups included "late-talking" toddlers, children with early focal brain injuries in either the right or left hemisphere (similar to those observed in adult aphasia patients), children with Williams syndrome, children with Down syndrome, and school-aged children with a diagnosis of specific language impairment, as well as appropriate typically developing controls (Bates, 2003).

For instance, in a longitudinal study comparing the lexical and syntactic development of late-talking toddlers, children with early focal brain injury, and typically developing children from 2 to 3 years of age (Thal et al., 2004), a number of interesting findings were reported. First, children in both at-risk groups exhibited significant delays in both vocabulary and grammatical development at both ages, and exhibited greater variability in language functioning than typical children (see also Kennedy, Sheridan, Radlinsky, & Beeghly, 1991). Second, different longitudinal associations be-

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tween language comprehension and syntactic development were observed in each group, suggesting that different language skills may be organized differently in specific clinical groups. Third, qualitative analyses indicated that the at-risk groups produced the same kinds of errors (despite relative delays). However, the late talkers produced a substantially greater proportion of errors in obligatory contexts than did children with early focal brain injury, a pattern consistent with that observed in older children with specific language impairment.

In several other studies from the San Diego collaborative group, the linguistic and pragmatic skills of school-aged children in different clinical groups were compared (Marchman, Saccuman, & Wulfeck, 2003; Reilly et al., 2004; Weckerly, Wulfeck, & Reilly, 2003; Wulfeck et al., 2004). Results showed that, by school age, children with early focal brain injury performed in the normal range on most language measures, regardless of lesion size or location, and outperformed children with specific language impairment. These findings shed light on the extent and nature of brain plasticity and recovery for language functioning in these groups. In addition, contrary to expectations, specific morphosyntactic measures of the children with specific language impairment with no frank neurological impairment clustered with those of the children with Williams syndrome, who were moderately retarded. Moreover, the performance of children with Williams syndrome on these language tasks was solidly linked to mental age (and often resembled that of children with specific language impairment), suggesting that children with Williams syndrome are not "language savants," at least for the measures evaluated in these studies, as several investigators in early studies have claimed (Bates, 2003). Reilly et al.'s (2004) results also highlight aspects of language and discourse that may be dissociable.

Contrasting results regarding the morphosyntactic development of children with Williams syndrome have been reported by other researchers (Clahsen & Almazan, 1998), which may reflect, in part, methodological differences across studies. For instance, Rice and others reported that 7-year-olds with Williams syndrome performed at near ceiling level in an elicited production task of finiteness morphemes, in contrast to the lower performance of language-matched children with specific language impairment and typical children (Rice, 2003).

In another series of cross-population studies, Tager-Flusberg and colleagues (see Tager-Flusberg, 2004a, for a review) demonstrated that a subgroup of children with autism with language impairment and language-matched children with specific language impairment exhibited a strikingly similar pattern of language skills. Children in both groups exhibited similarly poor performance and error patterns on tasks of nonword repetition and finite-verb morphology, suggesting that these children may share similar deficits in phonological processing and morphosyntactic knowledge. At the same time, children in both groups exhibited a relative sparing of articulation skills and verbal fluency. Interestingly, neuropathological findings in these groups are consistent with these language findings, suggesting the possibility of a common genetic etiological pathway to language disorder in the two groups (Tager-Flusberg, 2004a).

Need for Longitudinal Research

Further longitudinal studies of multiple aspects of language development in different clinical populations of children with language disorders are needed, especially during the period of time in ontogeny when language is acquired (Bates, 2003). Although costly and time consuming, such studies will allow us to evaluate the manner in which specific language behaviors in different domains emerge and change over time within different groups, and their potential linkages at various ages with genetic and neurocortical functions (Karmiloff-Smith & Thomas, 2003; Tallal & Benasich, 2002), higher order cognitive and socioemotional processes, and biological and social risk and resilience factors. Longitudinal designs will also allow us to evaluate within-group individual differences in profiles of language, cognitive, and behavioral skills over time, and describe the language phenotypes of subgroups of children more

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clearly and precisely (Tager-Flusberg, 2004b). Such research is critically needed to support and inform emerging studies evaluating the genetic and neurobiological etiology of different developmental language disorders.

To illustrate this need, Lord et al. (2004) noted that investigators in many prior studies of autism have tended to use general measures of verbal functioning (usually as control measures when evaluating the effect of autism on other cognitive or social skills such as theory of mind or central coherence). As a result, little is known about variations in different aspects of language (e.g., phonologic, semantic, morphosyntactic, pragmatic) among verbal children with autism, or (especially) how profiles among these different skills may change from early to later childhood. For instance, it is currently unclear whether children in the autistic spectrum disorders (or subgroups within this category) exhibit unique trajectories of language development from early to later childhood. Lord et al. contended that further understanding of the nature of these trajectories will have important implications for our understanding of the etiology and nature of developmental change within the autistic spectrum disorders, and children's potential response to treatment within this population.

In a rare long-term longitudinal study, children with autism exhibited an uneven developmental trajectory of their language and cognitive skills from the preschool period to adolescence (Sigman, 2005). Although about one-third of the children with autism made dramatic gains in cognitive and language skills from the preschool to the mid-school period, these gains had diminished dramatically (to less than half the change in their chronological age) by adolescence. Moreover, adolescents with autism and mental retardation exhibited almost no language gains. Notably, significant predictors of children's language functioning in adolescence were children's earlier functional play skills, responsiveness to others' bids for joint attention, and the frequency of requesting behaviors during the preschool period.

Further longitudinal studies in autism and other clinical populations are needed to shed light on how specific verbal and nonverbal cognitive and behavioral measures may be associated (or dissociated) at various points in time in ontogeny, and how functioning in different cognitive or socioemotional domains may support or derail language functioning in particular conditions or subgroups. An example of this type of longitudinal study comes from Mundy's programmatic research (see Mundy et al., 1993, for a review). In a 13-month longitudinal study of children with autism, Mundy et al. (1990) assessed the joint attention skills, pretend play behaviors, and language abilities of young children with autism and language-matched, mentally retarded children. All children were less than 5 years of age and were matched on receptive and expressive language age ($M = 12.5$ and 13.6 months, respectively). At the initial observation, joint attention deficits (but not requesting deficits) were observed in the children with autism, *before* functional or symbolic play deficits were observed in this sample. Of note, joint attention deficits were also observed for the children with autism at the follow-up visit, when play deficits *were* present. Moreover, children's initial joint attention (but not requesting) scores significantly predicted their symbolic play abilities at the time of the follow-up visit in the mentally retarded sample and approached significance in the autistic sample.

Mundy et al. (1990) speculated that nonverbal communicative and symbolic skills (i.e., joint attention and symbolic play skills) share a common source of variance and hypothesized that each may contribute to the development of children's language and social–cognitive and theory of mind abilities. Of note, Baron-Cohen, Allen, and Gillberg (1992) provided corroborative evidence that the joint attention and symbolic play deficits of children with autism are lawfully related. In their autism screening studies, the majority of toddlers who showed impairments in *both* joint attention skills and symbolic play in the second year received a diagnosis of autism later in childhood. In contrast, none of the toddlers who had deficits in only one domain or who had no deficits were diagnosed with autism.

Taken together, these findings suggest that joint attention skills precede the emergence of

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language and nonverbal symbolic play skills in children with autism, and may share variance with factors associated with the subsequent emergence of verbal and nonverbal symbolic functioning. Moreover, these results indicate that the type of associations and dissociations among cognitive and socioaffective behaviors associated with language development in children with autism may change in ontogeny.

Longitudinal cross-population studies such as these are necessary if we are to capture the dynamic, changing nature of language learning and its correlates in various clinical groups over time. One-time "static" snapshots of language behavior so often described in prior language studies are inadequate to capture the dynamic, transactional process of early language development and may yield misleading results (Karmiloff-Smith & Thomas, 2003).

In an intriguing treatise, Karmiloff-Smith (2001) argued that a key to understanding developmental disorders lies in the study of the dynamics of development itself, using a neuroconstructivist approach. Rather than focusing on single behaviors and "unidirectional chains" of single behaviors, she contended that investigators of language development in atypical populations need to evaluate the dynamic interplay among multiple contextual factors (e.g., genetics, brain/behavioral relations, and cognitive, behavioral, and environmental factors) on language and related processes from early infancy onward (see also Cicchetti et al., 1991; Thelen & Bates, 2003). Cicchetti et al. (1991) have further argued that it will be important to assess children's language and communicative competencies in multiple observational contexts that focus on stage-salient developmental issues (i.e., tasks that require the child to coordinate language, cognition, affect, and behavior) and vary in the degree of structure and challenge placed on the child. The overarching promise in such multifactorial longitudinal research is that it will yield detailed, age-specific information on early language and associated processes that will be useful to clinicians, educators, and other professionals in guiding and timing comprehensive intervention and rehabilitation programs for children exhibiting delayed or deviant language development and their families (Bates, 2003).

Genetic Bases of Language Disorders

Inquiry into the genetic bases of language disorders has gained momentum in the past decade, partly in response to the increasing number of behavioral phenotypic studies in different clinical groups, and partly from the hope that further knowledge of the genetic and environmental underpinnings of complex cognitive disorders can lead to more effective diagnoses and therapeutic interventions (Smith & Morris, 2005). In behavioral genetics studies of early language development in typically developing children, results of multivariate genetic modeling revealed a consistently high genetic correlation between vocabulary and grammar at 2 and 3 years, suggesting the same genetic influences operate for both vocabulary and grammar (Dionne, Dale, Boivin, & Plomin, 2003), a finding that is inconsistent with an "autonomy" hypothesis. In addition, results of crosslagged longitudinal genetic models showed that both lexical and syntactic bootstrapping operate from 2 to 3 years. In other behavioral genetics research, a complex interplay between genetic and environmental influences was associated with the timing and process of early language development (Spinath, Price, Dale, & Plomin, 2004), suggesting the need for complex, dynamic systems approaches in future genetic studies of language disorders (Thelen & Bates, 2003).

Two contrasting neurocognitive approaches ("top-down" and "bottom-up") have recently been described that hold promise for future studies examining genetic contributions to language disorders. Generally speaking, in a top-down approach, the investigator focuses on an "optimal" phenotypic description of language behavior in a genetic disorder and then attempts to understand its genetic and biological underpinnings, often using electrophysiological brain measures (Phillips, 2005). In contrast, in a bottom-up approach, the investigator focuses on primary etiological pathways for language disorders and attempts to explain complex "outcome phenotypes" in terms of more fundamental, underlying diffi-

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culties, such as those observed in early-emerging sensorimotor behavior (Muller, 2005).

Both approaches are likely to be valuable, and each has the potential to identify gene effects at various levels of language processing and to describe specific genetic and neurological pathways contributing to language disorders (Rice & Warren, 2005b). For instance, advances in neuroimaging techniques (e.g., event-related potential, functional magnetic resonance imaging [fMRI], and near infrared spectroscopy) during the past 15 years have indicated that neurocortical measures such as these hold great promise for top-down genetic research in developmental language disorders. In studies of typically developing older children and adults, functional neuroimaging data have led to a greater understanding of the ways that dynamic neurocortical systems subserve higher level cognitive processes such as language. Moreover, fMRI studies in older children with specific language impairment or autism have yielded interesting corroborative information regarding behavioral findings in these disorders, with implications for our understanding of brain/behavior relations (Carpenter et al., 2001; Nelson et al., 2002).

However, caution is needed in interpreting findings from this literature, given methodological variations in the use of these techniques across laboratories and related validity and reliability issues (Billingsley-Marshall, Simos, & Papanicolaou, 2004). Further development and refinement of these techniques are needed. A major obstacle for the incorporation of these techniques in research on early language acquisition is that some neuroimaging techniques (e.g, fMRI) cannot be used successfully with infants and young children. This is due to technological limitations regarding movement artifacts, as well as ethical problems associated with sedation (see Nelson et al., 2002; Phillips, 2005, for reviews).

Another methodological obstacle to genetic research in language disorders is that both the top-down and bottom-up methods require accurate, thorough descriptions of language phenotypes (and related cognitive and behavioral processes) in different populations of children with language delays and disorders. Clearly defined phenotypic measures are also necessary to inform and support cellular and molecular studies that will, in turn, lead to the identification of genes that contribute to the complex pathways affect language development and disorders (McCardle et al., 2005).

Unfortunately, precise phenotypic descriptions of many aspects of language and related phenomena do not currently exist (Rice & Warren, 2005b). Part of the problem in coming up with a set of precise, "optimal" measures of language phenotypes in different clinical populations is that investigators from different disciplines have tended to focus on different language phenomena at different ages, with concomitant differences in preferred assessment paradigms and operational definitions of measures. To address and overcome some of these obstacles, Mervis and colleagues (Mervis & Klein-Tasman, 2004; Mervis & Robinson, 2005) have provided several helpful methodological caveats for researchers in this field.

First, the most useful dependent measures of "optimal language phenotypes" (at least in initial studies) are those that assess narrowly defined language behaviors, can be used longitudinally with demonstrated reliability and validity, and can be utilized reliably by different investigators in different laboratories. This is especially important in multisite, cross-population comparative studies. In addition, given the growing cultural diversity in the United States, measures should be selected that recently have been normed (or renormed) for age and gender on geographically and racially representative national samples. Measures that are "culture free" and can be used appropriately in multicultural groups are especially desirable. Moreover, particular phenotypic measures should be selected for genetic evaluation that have known genetically related variation (heritability) in different populations, ideally those that have been shown to be consistent over time and within families, as determined in prior behavioral genetics studies (Mervis & Robinson, 2005).

Second, Mervis and Klein-Tasman (2004) provide caveats pertaining to group-matching designs, which are commonly used to identify diagnosis-specific characteristics of children with language disorders. For instance, they

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describe the alpha levels needed for control variable comparisons, recommend the use of raw or standard scores rather than age equivalent scores when evaluating group differences on developmental matching variables, and advocate the use of sensitivity and specificity criteria to delineate membership in the target and control groups.

Third, Mervis et al. recommend that investigators eliminate from their study samples (or control for as much as possible) subjects with secondary behavioral or psychiatric conditions (e.g., attention deficit/hyperactivity disorder, depression) or environmental and biological risk factors (e.g., prematurity, prenatal substance exposure, teen parenting) that can co-occur with language disorders and confound interpretation in genotype/phenotype analyses. Assurance that target and comparison groups are matched carefully for gender, race/ethnicity, and sociodemographic characteristics (in addition to developmental features) is also of critical importance.

Fourth and finally, collaborative, multisite cross-population studies of language disorders are encouraged, because they can increase sample size in studies of rare disorders (such as Williams syndrome), overcome problems associated with subject attrition, and make the maximum use of the data. Furthermore, ideal collaborations would be multidisciplinary and incorporate input from scholars in genetics, molecular biology, linguistics, neuroscience, and psychology.

However, cross-site communication in multisite collaborative research is not a simple or easy task. To initiate and maintain effective, successful collaborative research, it will be important to coordinate efforts and methods across multidisciplinary groups prior to start up. As detailed by Mervis and Robinson (2005), key constructs to be measured need to be identified, agreed-upon, and defined, using similar measures, instruments, and assessment paradigms across laboratories. In addition, investigators at different sites should utilize the same design (including specific child ages of assessment and control groups) and statistical analyses, to allow for data archiving and data sharing. Accomplishing these goals will require the implementation of procedures to promote excellent cross-site communication and reliable systems (e.g., a central site) for monitoring quality control at all phases of data collection and reduction.

Individual Differences and the Effects of Biological and Social Risk and Resilience Factors

Within-group variation in language and associated cognitive and behavioral skills is a hallmark feature of many clinical groups of children with delayed or disordered development (Kennedy et al., 1991; Lord et al., 2004; Mervis, 2003; Tager-Flusberg, 2004a; Thal et al., 2004; Tomblin, Zhang, Weiss, Catts, & Weismer, 2004), yet the primary focus in many prior comparative studies has been on describing average group differences in language performance, which can obscure within-group variations. Thus, there is an urgent need for investigators in future translational language research to evaluate individual differences within clinical groups of children with language delays and disorders. This shift in focus will allow for further analysis of data collected in within-group studies and the identification of possible subgroups of children with unique profiles of linguistic, cognitive, and behavioral skills, with implications for both genetic and intervention studies (Lord et al., 2004; Tager-Flusberg, 2004b).

It will also be important in future translational language studies to evaluate the effects of contextual risk and resilience factors that are known to affect variations in language acquisition. Factors such as child gender, temperament, parenting style, and biological and social risk and resilience factors on children's language functioning have been shown to affect children's language performance in both typically developing and various at-risk groups but have been largely ignored in prior research in children with developmental language disorders (Blacher, Kraemer, & Schalow, 2003; Dykens, 2003; Mervis & Robinson, 2005; Torr, 2003). A brief review of this literature is provided here for illustrative purposes.

In typical development, language acquisition usually emerges rapidly and follows a

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predictable sequence during early childhood. By the end of the preschool period, most typically developing children have mastered the basic components of speech and language development, including a rich, varied lexicon, diversity in semantic and morphosyntactic applications, and pragmatic skills (Berko Gleason, 2005). Moreover, a large body of normative research suggests that there is marked similarity across different ethnic and language groups in the onset and mastery of these skills (Berko Gleason, 2005; Tomasello & Bates, 2001).

However, individual differences in the style and rate of early language acquisition are well documented (Fenson et al., 1994; Shore, 1995). Robust effects of biological and social contextual factors such as child gender, temperament, birthweight premature birth, caregiver interactive style, culture, and demographics on multiple specific aspects of language development have also been reported, which may account for some of this variation (Bates et al., 1994; Goldfield & Snow, 2005; Hart & Risley, 1995; Landry et al., 1997; Massey, 1996; Morisset, Barnard, & Booth, 1995; Spiker et al., 2002).

Caregiving factors are especially critical to consider, as individual differences in early language acquisition have been strongly linked to both distal and proximal measures of the caregiving environment, such as parental education, maternal psychosocial adaptation, and parental interactive style, including the amount and quality of verbal input to the child (Messer, 1994). For instance, low socioeconomic status is often linked with delayed language acquisition. Results of a large, home-based observational study showed that parents from low SES homes spoke significantly less to their young children than parents from middle-class homes (Hart & Risley, 1995), suggesting that the effect of low SES on children's language development is mediated by SES-related variations in parental verbal input to children. In other research, variations in caregiving have been linked to children's language outcomes within low-income samples. For example, in a longitudinal study of African American preschoolers from low-income families, a global measure of maternal responsivity and support in the home environment predicted children's language and early literacy skills (Roberts, Jurgens, & Burchinal, 2005). Similarly, in another longitudinal study of mostly Caucasian low-income toddlers' vocabulary development between 1 and 3 years of age (Pan, Rowe, Singer, & Snow, 2005), maternal lexical input and maternal language and literacy skills exerted positive effects, whereas maternal depression exerted negative effects, on toddlers' lexical outcomes. Moreover, extreme perturbations in the caregiving environment, such as child maltreatment, are strongly associated with delays in children's lexical, syntactic, and pragmatic development during early childhood, even after controlling for general cognitive status (Beeghly & Cicchetti, 1994; Coster, Gersten, Beeghly, & Cicchetti, 1989; Eigsti & Cicchetti, 2004).

At a more proximal level, specific variations in maternal verbal input and sensitivity or responsivity to children during mother–child interaction have been linked with the rate of children's language development, in both typically developing and at-risk groups (Dale, Greenberg, & Crnic, 1987; Dunham & Dunham, 1992). For instance, in multivariate longitudinal studies of children's vocabulary development, Bornstein and colleagues (Bornstein, 1998) showed that mothers' spontaneous expressive vocabulary to their infants uniquely predicted infants' comprehension at 20 months. Effects of variations in the socio-affective quality of parent–infant relationship on language outcomes have also been reported. In a meta-analytic review (van Ijzendoorn, Dijkstra, & Bus, 1995), the quality of attachment between infant and parent was strongly associated with the infant's language development. Similarly, in a study of medically high risk toddlers, additive effects of a secure mother–infant attachment relationship and home stimulation on children's language competence (especially receptive skills) were observed (Murray & Yingling, 2000).

Several investigators have suggested that variations in maternal interactive style and sensitivity may exert stronger effects on early linguistic development when children are at risk for language delay due to the presence of social or biological risk factors (Baumwell,

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Tamis-LeMonda, & Bornstein, 1997; Beeghly & Cicchetti, 1994). For instance, in Landry's programmatic longitudinal research on prematurely born infants with varying biological risk characteristics, maternal interactive style characterized by a high prevalence of maintaining (rather than redirecting) of the child's focus of attention during dyadic interactive tasks was associated with longitudinal gains in children's language, cognitive, and social functioning in both term and prematurely born children, with larger gains seen in the higher risk preterm groups (see Landry, Miller-Loncar, & Smith, 2002, for a review). Similarly, in a large longitudinal study of the effects of child care on children's outcomes, maternal sensitivity during mother–child interactions from infancy through 36 months mediated the effect of chronic maternal depressive symptoms on children's cognitive and linguistic outcomes (NICHD Early Child Care Research Network, 1999).

Although understudied, similar caregiving effects have been observed in language studies of children with a variety of developmental disabilities. For instance, in experimental intervention studies of children with language delays and with Down syndrome, Yoder, Hooshyar, Klee, and Shaffer (1996) showed that mothers' responsive linguistic behaviors that were fine tuned to their infants' language skills predicted gains in their children's syntactic development. In another study (Yoder & Warren, 1999), maternal verbal responsivity mediated the relationship between children's prelinguistic intentional communication and later language skills. In a study of the early predictors of language in children with and without Down syndrome (Yoder & Warren, 2004), parental verbal responsivity predicted children's later productive language above and beyond etiology. Similarly, in a prospective study of hearing mothers and their deaf and hard-of-hearing children (Pressman, Pipp-Siegel, Yoshinaga-Ito, & Deas, 1999), maternal affective sensitivity to toddlers during mother–child interaction was significantly, positively associated with children's expressive language gain, even after controlling for maternal education, degree of child hearing loss, dyadic mode of communication, and other covariates.

Of course, the direction of effects in these studies is unclear, given that development is dynamic and transactional in nature (Abbeduto & Murphy, 2004; Bates et al., 1982). Parents' psychosocial well-being and interactive style with children are also affected by variations in the child's own developmental and behavioral status. What is still unclear (and deserves further evaluation) is how children's developmental and socioemotional behavioral characteristics affect others' responsivity to them and how this transactional process may indirectly contribute to the quality of child's language-learning environment over time (Abbeduto & Murphy, 2004).

Gene–environment interactions in language disorders

Several investigators (Abbeduto & Murphy, 2004; Hodapp, 1997, 2004) have suggested that, because factors from multiple levels of influence affect the trajectory of children's language development, gene–environment interaction effects on language outcomes in clinical groups are especially likely and should be evaluated. An effective way to study this would be to evaluate the ways in which children with different genetic disorders (e.g., Down syndrome, Williams syndrome, or autism) use language with others in social contexts, and how variations in children's communicative style affect others' responses to them over time. It is possible that the resulting specific child–environmental interchanges in different groups or subgroups could gradually affect the developmental trajectory of those children's profile of language skills and alter their phenotypic manifestation of genetically based behavioral predispositions. Putatively, these indirect genetic effects could also affect children's functioning in other domains (e.g., cognitive processes, socioemotional behavior).

Although intriguing, evaluating gene–environment interactions in translational language research (especially at an individual level) is likely to be complex and difficult. For instance, it remains to be determined which specific aspects of the child's language and communicative behavior affect others, whether these effects persist over time, and whether

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these effects are specific to a single disorder or are generalizable to all children with similar profiles in other groups (Hodapp, 2004).

Cumulative risk

Longitudinal research with at-risk groups of children has shown that the presence of multiple risk factors may be stronger predictors of children's language and other developmental outcomes than single risk factors. In several studies of preterm birth, for instance, infants with lower gestational age and birth weight, along with additional comorbid biological risk factors (e.g., chronic lung disease, white matter brain injury) performed more poorly on tests of language ability than their lower risk counterparts (Briscoe, Gathercole, & Marlow, 1998; Landry, Miller-Loncar, & Smith, 2002). Similarly, in a longitudinal study of the effect of prenatal cocaine exposure on low-income children's language outcomes at 6 and 9.5 years of age (Beeghly et al., 2006), children with both prenatal cocaine exposure and lower birthweight had more compromised expressive language functioning than exposed children with higher birthweight or unexposed children.

Taken together, this literature confirms that biological and social contextual variables from multiple levels of influence can alter the trajectories of children's language development, whether children are developing typically, atypically, or at risk for developmental problems. Therefore, investigators in future translational research on language development should measure and evaluate these contextual factors carefully. As Zigler (1971) contended, children with developmental delays or disabilities are children first, and thus investigators need to take an integrated, "whole-person" approach to their study.

Clinical Implications

Let us now return to the clinician's predicament raised at the beginning of this paper. How can results from longitudinal cross-population research on early language development in at-risk and atypical groups be "translated" into more effective evidence-based clinical practice?

Translational research on early language development has many implications for clinical practice. A few compelling examples are provided here.

First, translational research on atypical language development to date has shown that there are striking individual differences in language acquisition and related cognitive and behavioral processes within different clinical groups and subgroups of children, as well as striking commonalities across conditions. The provision of further detailed information about these cross-population similarities and differences in language profiles and documentation of subtypes within populations would enhance clinicians' ability to identify young children who are likely to develop clinically significant language-learning problems and would enhance clinicians' understanding of the different levels of risk that may predispose very young children for persistent language impairment (Thal et al., 2004). Moreover, this information would help clinicians individualize and customize existing programs and intervention strategies for different children and maximize their effectiveness (Abbeduto & Murphy, 2004).

Second, further longitudinal evaluation of the unique trajectories of language development within and across different clinical groups would shed light on how profiles of abilities within or across clinical groups change or remain the same over time (Lord et al., 2004). This research would also identify the specific contextual factors (biochemical, neurocortical, or environmental) that may be triggering these age-related changes (Rice, 2004). This information would allow clinicians to anticipate accelerations and decelerations in specific skills in different subgroups at different ages, and tailor and fine-tune interventions for individual children at different levels of language functioning in developmentally appropriate ways.

Third, translational research documenting the specific cognitive and behavioral precursors of language development (e.g., joint attention, pretend play) in different clinical groups may assist clinicians in identifying more accurately and at earlier ages children who are at risk for persistent language problems

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(Yoder & Warren, 2004), which would allow these children to receive intervention services as early as possible. Research suggests that intervention services are most effective when received during infancy and toddlerhood (Guralnick, 1997; Leonard, 1998).

Fourth, the identification of specific biological and social risk factors that may support or derail children's language development in different clinical populations would further assist clinicians in the early identification of children at risk for language problems and offer insights into the most effective interventions. Tomblin, Hardy, and Hein (1991) have suggested that information regarding children's biological and family risk status could help clinicians identify those at greater risk for communicative impairments more clearly. For instance, in their retrospective study of the speech and language status of 662 children between 30 months and 5 years of age, a set of multiple risk factors comprising various family background and birth history variables predicted 55% of children with poor communication skills and 76% of those with normal communicative development (Tomblin et al., 1991).

Regarding the development of effective treatment programs, results from intervention research documenting the efficacy of different types of parental verbal responsivity on children's language outcomes could be incorporated into ongoing parenting programs to maximize their effectiveness (Yoder & Warren, 1999, 2004). More generally, reduction of the overall level of risk for individual children and their families and provision of social support at multiple levels may do much to facilitate positive child developmental outcomes (Dunst, 2000; Tronick & Beeghly, 1999). For instance, results from intervention research spanning nearly three decades (Olds, 2006) have shown that general and specific prenatal and infancy preventive interventions for low-income families provided by home visiting nurses can significantly improve parental care and are associated with better infant and emotional outcomes, particularly for families at greater risk.

Fifth and finally, longitudinal translational research on the efficacy of different intervention programs could provide valuable information to clinicians regarding the relative efficacy of different types of intervention programs on parenting and child language outcomes in different clinical groups, whether these effects vary for children at different ages, and whether different approaches are needed for families from different socioeconomic and cultural backgrounds. Such research could also shed light on how specific intervention parameters (intensity, duration, comprehensiveness of service) may affect parental adaptation, parenting, and children's language outcomes in different clinical groups (see, e.g., Hauser-Cram, Warfield, Shonkoff, & Krauss, 2001; Warfield, Hauser-Cram, Krauss, & Upshur, 2000).

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