10

Language in mental retardation: Associations with and dissociations from general cognition

ANNE E. FOWLER

Language specificity has been a central theme of recent research on language acquisition and language processing in persons with mental retardation (MR). The phenomenon of specificity is invoked by the general finding that (1) variability in language skill cannot be fully explained by general cognitive factors; and (2) some components within language are themselves separable. Although full linguistic mastery necessarily involves a combination of lexical, morphosyntactic, phonological, and pragmatic skills, it is becoming increasingly evident that these components may be differentially impaired or spared in persons with MR, especially beyond the earliest stages of development. In this chapter, which focuses on later language learning, these four language components will be considered separately to allow more detailed discussion of the nature and basis of language impairment in MR.

Importantly related to this idea of language specificity is the growing appreciation that children of different etiologies but similar IQ scores may have dramatically different linguistic profiles. Indeed, within the topic of MR language, perhaps the greatest progress in the last decade concerns the description of distinct linguistic profiles in Down syndrome (DS), Williams syndrome (WS), autism, and fragile X syndrome (fra(X)), as well as in other less studied etiologies. This chapter attempts to convey some of that progress, both descriptive and explanatory.

Over the last 10 years, the study of language in persons with MR has also benefited from advances within developmental and cognitive psychology. For example, extensive work on pragmatic function in MR reflects a more general interest in the social context of language and cognition. Inspired by advances in cognitive and language development, researchers have become far more analytic about the nature of lexical

knowledge and have developed new strategies for assessing morphology and syntax. Research on specific language impairment (SLI) and dyslexia has considerably enriched our understanding about what qualifies as, and might follow from, individual differences in phonological skill. In turn, through study of language in persons with MR, psychologists and neuroscientists have made a promising start toward identifying the cognitive and biological basis of language impairments, pointing the way toward future endeavors and providing an important foundation for intervention.

Specificity of language function

It has long been assumed that the examination of language in persons with MR can provide a window on the intersection between language and cognition. In one of the first papers to take up this topic explicitly, Cromer (1974) suggested that language may be predicated upon, and hence limited by, more general cognitive factors (see also Bates, Thal, & Janowsky, 1992; Maratsos & Matheny, 1994). Other discussions (e.g., Bates & Snyder, 1987; Cromer, 1991; Vygotsky, 1962) emphasize a reciprocal interaction between language and cognition: Language is not only limited by cognition, but cognition (especially thinking, planning, and reasoning) is also limited by language and by the interaction patterns thereby afforded. Many investigators have considered how more basic information-processing factors (e.g., perception, memory, sequential processing, use of metacognitive strategies, rule learning, speed of processing) might affect both language and cognitive function (e.g., MacKenzie & Hulme, 1987; Marcell & Weeks, 1988; Varnhagen, Das, & Varnhagen, 1987). Most recently, but still stressing an across-the-board mechanism, theorists (e.g., Bates, 1992, Locke, 1994) have stressed the significant role played by knowledge structures in language development, considering how limited input and a limited data base, especially during the language-learning years, can result in an impoverished linguistic system.

Consistent with each of these accounts is the fact that language difficulties are highly prevalent in persons with MR. Indeed, of several hundred articles on MR language reviewed for this chapter, not one claimed that there was *no* effect of MR on at least some aspect of language function during development. Although more formal estimates of the coincidence of language and cognitive deficits are outdated and woefully flawed by wide variation in measures used and in the ages sampled, they suggest that somewhere between half and all children with MR also present significant language delay (e.g., Jordan, 1976). Further evidence of the close association between language and cognition is the common observation that language delay is the single most important reason why parents choose to have their child assessed for learning difficulties.[1]

Of course, given the very phenomenon of "specific language impairment" (SLI) in which children of otherwise normal intelligence exhibit severe expressive (and sometimes receptive) language delay, it is clearly not the case that well-developed cognitive skill assures (or necessarily implies) well-developed language skill; the deficits are most obvious in phonological and morphosyntactic function (e.g., Bishop & Adams, 1990; Gathercole & Baddeley, 1990; Rapin, Allen, & Dunn, 1992). What is especially interesting is similar evidence of specific linguistic deficits in persons with MR, as are often found in DS (e.g., Fowler, 1990; Miller, 1988) as well as in X-chromosome disorders (e.g., Walzer, 1985). Language delay disproportionate to the level of cognitive delay is observed even in persons who are only mildly retarded, especially beyond an MA (mental age) level of 5 years (e.g., Abbeduto, Furman, & Davies, 1989). Vig, Kaminer, and Jedrysek (1987) studied 38 disadvantaged youngsters with "borderline to mild retardation." When first evaluated at 2 to 4 years of age, 15 of these youngsters had significant language delay below MA expectations, and 23 scored roughly equivalently on verbal and performance measures. Not only was general cognition not a reliable indicator of language function at the outset of the study, but it failed to predict language skill 3 years later. Suggesting a surprising lack of interaction between cognition and language over the preschool years, the best predictor of later language was initial language score; the best predictor of later cognition was initial cognition score.[2] Indeed, in one of a handful of studies in which children with MR achieved productive language levels nearly equivalent to those of typically developing children matched on MA (4–6 years), Kamhi and Johnston (1982) excluded from the MR sample any child who qualified for speech-language therapy or who showed evidence of organically based MR.

These data overall suggest that certain general cognitive structures are necessary, if not sufficient, for language development to proceed (e.g., Bates et al., 1992; Cromer, 1976). In the study that prompted him to introduce this "weak view" of the cognition hypothesis, Cromer (1974) asked children and adolescents with MR to act out sentences such as *John is eager/fun to bite*. Participants with MA-levels below 6.5 years consistently interpreted all verbs as applying to the agent of the sentence (*John is biting*), consistent with the pattern of typically developing preschoolers. However, only a subset of those participants with MA-levels higher than 6.5 years evidenced any shift toward the adultlike pattern of attending to adjective-specific control properties (given *eager*, John does the biting; given *fun*, someone else bites John). Guided by these data, which suggest a shift in language performance coincident with achievement of concrete operations, Cromer argued that the development of cognitive concepts are essential for establishing those meanings which can be encoded in

language, but only if the child also possesses the specific linguistic capabilities to do so.

A more comprehensive test of the cognition hypothesis was undertake by Miller, Chapman, and Bedrosian (1978), who evaluated 78 childre (CA 1 to 14 years, MA 0 to 7 years) for possible mental retardation. C these, only eight children were identified whose performance on at leas one of the many language dimensions surpassed their cognitive level b at least one year; six of these were functioning in the late preoperationa period (MA 5 or 6), but were relatively advanced in syntactic productio comprehension, and/or phonological production. All eight exceptior displayed receptive vocabulary knowledge (PPVT-R, Dunn &Dunn, 1981 well in advance of what would be predicted on the basis of general cog nitive measures. Miller et al. (1978) concluded that the "cognitive statu of the child, regardless of delays relative to chronological age, provided unidirectional limitation on language performance in 90% of their sul jects" (p. 14).

Recent studies suggest that Miller et al.'s (1978) results may well rej resent the larger picture. That is, language acquisition *typically* lags behin MA-level expectations but exceeds them just often enough to deman explanation. In the last few years, researchers have documented severa cases of highly sophisticated linguistic skill in adolescents with otherwis extremely limited intellectual abilities; like the exceptions in Miller et al these cases typically involve relatively advanced syntax and/or vocabular in children (MA 5 or 6 years) who have not attained concrete operatio and who perform poorly on a variety of nonlinguistic cognitive task Cromer (1994), retreating from his earlier hypothesis, provided strikin evidence for well-developed syntactic function in a severely retarded ac olescent with spina bifida and arrested hydrocephalus. Despite achievin a full-scale IQ of 44 on standardized and experimental measures of inte ligence, this young woman's speech was fluently and correctly articulate including use of an extensive vocabulary, complex syntactic forms, accu rate grammatical morphology, and normal pragmatic function. An eve more dramatic case was presented by O'Connor and Hermelin (1988 who document the case of a linguistically exceptional 29-year-old man wit hydrocephalus; despite overall levels of retardation, that man achieved PPVT-R score of 121 and could translate English into three languages.

Still further evidence of linguistic function apparently spared in the fac of otherwise limited cognition derives from recent research on childre with Williams syndrome (WS), a rare metabolic disorder leading to mo erate to severe retardation and uneven cognitive profiles (e.g., Bellug Birhle, Jernigan, Trauner, & Doherty, 1990; Bellugi, Marks, Birhle, Sabo, 1988; Udwin, 1990; Udwin, Yule, & Martin, 1987). Such childre begin with delayed syntactic development, but then move ahead to acqui

full syntactic complexity despite preoperational functioning on Piagetian tasks, and despite severely impaired spatial functioning. The three adolescents presented in Bellugi et al. (1988) displayed extensive use and comprehension of passives, questions, embedded clauses, conditionals, and multiple embeddings, with nearly accurate grammatical morphology, and age-appropriate receptive vocabulary. They could imitate sentences of almost any verbal complexity, produced a torrent of low-frequency items in a verbal fluency task, and could detect and correct sentences containing grammatical violations. These results have been interpreted to suggest that "maturation of language processes may not always depend on the maturation of conceptual processes, since some children with defective conceptual systems have nonetheless acquired grammar. The neural machinery for some syntactic operations does seem capable of developing autonomously" (Damasio & Damasio, 1992, p. 89).

Even in Down syndrome, which is typically characterized by a failure to acquire complex syntax, interesting exceptions do exist (e.g., Seagoe, 1964). Rondal (1994, 1995) presents the case of a mildly retarded young woman named Françoise whose production and comprehension of syntax is accurate and complex (with a mean length of utterance [MLU] of 12.24), whose grammatical morphology is consistently accurate, and whose phonological skills are excellent, including articulation, fluency, and intonation patterns. Françoise's nonlinguistic capacities are markedly below her grammatical achievement. She has not fully achieved concrete operations, and earned a nonverbal MA of 5 years, 8 months, in contrast to her verbal MA of 9 years, 10 months. (For still further cases of spared linguistic function together with severe retardation, see Curtiss, 1988a, 1988b; Yamada, 1990).

In summary, most persons with MR achieve language levels either consistent with or (more commonly) below MA expectations, suggesting that at least some aspects of language development share common resources with general cognitive development. However, in some well-studied instances, linguistic function exceeds (or falls dramatically below) MA-level expectations, indicating that at least some parts of language develop independently of some parts of cognition. Notably, the association between MA and language development becomes considerably weaker beyond an MA of 5 years. This point was made explicitly by Abbeduto et al. (1989) and Miller et al. (1978); it also appears that those MR individuals with "spared" language are functioning in the late preoperational period. It would, at the very least, appear that achieving concrete operations is not required for higher-order syntax.[3] It must be acknowledged, however, that general cognitive factors may play an important limiting factor earlier in development, suggesting some threshold effects in language development (e.g., Bates et al., 1992). It must also be emphasized that much of the linguistic "sparing" relates to morphosyntactic skill, rather than con-

sidering language as some single dissociable function. In the remainder of this chapter, research is reviewed within the context of individual language components, in order to better describe how each of these components is or is not associated with other well-defined aspects of language and cognition. With some important caveats, it will be suggested that pragmatics and semantics are more closely tied to MA/IQ than are phonology and morphosyntax.

Pragmatics

The last 10 years have witnessed considerable research activity in *pragmatics* – or *communication* – which refers to the ability to use language appropriately and in appropriate contexts, taking account of the listener. Pragmatics includes both nonverbal communication (e.g., eye contact, gestures, facial expression, intonation) and verbal interaction (e.g., turn taking, topic maintenance, adaptations to the listener). One reason for the recent interest in pragmatics is its potential separability from other aspects of linguistic function. In particular, it is hypothesized by many investigators that the core deficit in autism is a failure to take account of another's cognitive or mental state, or to construct what is known as a "theory of mind" (e.g., Baron-Cohen, Tager-Flusberg, & Cohen, 1992; Frith, 1989; Leslie & Frith, 1988). Consistent with this account, persons with autism demonstrate severe impairment in pragmatics relative to MA, and perhaps even relative to other aspects of linguistic function (e.g., Tager-Flusberg, 1981). Other studies looking at relative weaknesses in pragmatic function have focused on persons with Williams syndrome (whose morphosyntax is generally superior) and on males with fragile X syndrome (who often have "autistic-like" qualities).

A number of researchers have investigated pragmatics in its own right, asking how it is that persons with MR manage the complex task of conversation, and how they might be more effective. This has particular relevance as more children and adults with MR enter the mainstream community, where the social consequences of MR are great (e.g., Hemphill & Siperstein, 1990). A better understanding of the communicative competence of persons with MR is also relevant for assessing and remediating language skill: Children with MR may function far more effectively in some communicative settings than in others (e.g., Yoder & Davies, 1992; Yoder, Davies, & Bishop, 1994).

Communication interactions in persons with mild MR

In high-functioning MR adults with fully developed phonology and morphosyntax, conversational interactions may be the one feature that reveals their underlying cognitive difficulties. Rosenberg and Abbeduto (1993)

suggest this is because communication involves much more than the knowledge of language, requiring cognitive and social skills as well as knowledge about the communicative process itself. In an extensive review of this topic, they report that in no study is there evidence that persons with MR achieve communicative competence that exceeds expectations based on MA, indicating that "there are important cognitive prerequisites for many pragmatic achievements" (p. 161). In addition to their more obvious cognitive deficits, Beveridge and Conti-Ramsden (1987) stress the fact that persons with MR also have social risk factors. They review data suggesting a lack of synchrony in early parent–child interactions, the child often being passive and unresponsive, and the parent often adopting a more dominant, teacher-like role. They discuss research pointing to differences in the schoolyard, where children with MR tend to engage in solitary play entailing minimal social interaction, and where deficits in peer-related social confidence exceed MA-based expectations. They remind us of evidence that children with MR tend to be nonassertive and deferential with their normal-IQ peers, who in turn tend to command. Even those children who are verbally aggressive and hostile can be seen as having difficulty understanding the social demands of different contexts. In the classroom, too, children with MR tend to be reluctant to recruit a teacher's assistance to solve problems, to ask for materials, or to question assignments. In short, persons with MR have a host of social and cognitive difficulties they must overcome in order to communicate effectively.

In fact, persons with MR often do acquire extensive pragmatic competence (e.g., Bolognini, Guidollet, Plancheral, & Bettschart, 1988; Oetting & Rice, 1991; Rosenberg & Abbeduto, 1987). For example, in an examination of peer-group conversational behavior among mildly retarded adults, Rosenberg and Abbeduto found that they not only displayed mastery of the morphosyntax of English, they also showed appreciable mastery of conversation, including turn taking, expressing and recognizing assertions, questions, and directives, topic introduction and maintenance, and means for making and responding to requests for clarification.

If less effective, most children and adults with MR use communicative strategies that are qualitatively similar to those of younger normal children. For example, although persons with MR have difficulty describing referents in an unambiguous fashion (e.g., Rueda & Chan, 1980), and rarely ask for clarification of ambiguous messages themselves, children with mild to moderate MR can incorporate context to resolve referential ambiguity much like MA-matched younger children (Abbeduto, Davies, Solesby, & Furman, 1991). In the relevant study, children played "storekeeper," responding to the ambiguous requests of a "customer." When the requests described two objects for sale equally well (e.g., "give me the cup"), children with MR, like younger controls, incorporated contextual information in making their response (e.g., choosing the child's cup if the customer mentioned they were shopping for a child). Children with MR also display normal pragmatic responses when asked a series of interrogatives that could be interpreted as having either directive and/or a question intent (Abbeduto, Davies, & Furman, 1988). Like younger children matched on MA, they interpreted questions as directives when the answer was obviously based on the prior context (e.g., "Could you turn the flashlight on?" after having done so several times) and interpreted them as questions when the answer was not obvious. Abbeduto et al. suggest that knowledge of these communicative devices does not depend on syntax, because pragmatic performance in his sample exceeded performance on a structural language measure developed by Bishop (1982).

Of course, difficulties exist even when patterns of communication are qualitatively normal. For example, children and adolescents with mild MR put in the position of asking for art materials were able to vary the politeness of their requests in accordance with the addressee's affect (sad/happy) and activity (occupied/unoccupied), demonstrating that they knew the polite forms. And yet their greater tendency overall to use the less polite "Another one" instead of "Can I have another?" may mark them as socially inept in comparison to typically developing children of comparable MA (Nuccio & Abbeduto, 1993).

One area of particular weakness for persons with MR concerns the ability to establish a referent when retelling or creating a story. For example, when children with mild MR and typically developing children matched on MA were asked to tell a story from a wordless picture book, the children with MR were less likely to use indefinite articles appropriately to introduce new characters, even after controlling for possible differences in recalling the story (Hemphill, Picardi, & Tager-Flusberg, 1991). In contrast, the groups did not differ in narrative length, morphological and lexical diversity, or use of narrative devices. (See Kernan & Sabsay, 1987, for similar results in a study of adults with DS.)

Pragmatic deficits in autism

As noted earlier, a defining feature of autism includes an inability to take another's perspective or appreciate another's thoughts or intentions, as assessed on a variety of theory-of-mind tasks (e.g., Wimmer & Perner, 1983). Consistent with this conceptual deficit, many studies have documented pragmatic weaknesses in autism incommensurate with MA. For example, when asked to explain to a listener the rules of a board game they themselves had just learned, high-functioning adolescents with autism were significantly less effective than adolescents with DS matched on ver-

bal MA (Loveland, Tunali, McEvoy, & Kelly, 1989). Given a general prompt, the group with DS produced more adequate responses, including effective use of gestures; the group with autism required significantly more and more specific prompting to produce target information and used gestures ineffectively.

The communicative patterns of persons with autism are also characterized by several unusual features, including repeating another's utterances exactly without altering the pronouns, pronoun reversal, reliance on stock phrases, and talk irrelevant to the topic of conversation. In one well-documented case, a 9-year-old with autism (IQ 58, MLU 2.5, Social Age 6.2) repeated the phrase "Can I talk?" 618 times, comprising 23% of his utterances to his father, and 12% of his utterances to the experimenter in recordings made over a 9-month period (Coggins & Frederickson, 1988). It was argued that Bryan did not so much avoid interactions as lacked the necessary linguistic skills to regulate them effectively. This phrase provided a means to manipulate and maintain social interactions.

An obviously important question concerns how much of these pragmatic deviances are a means of overcoming structural linguistic problems. It has been noted, for example (Roberts, 1989), that autistic children with poor receptive language skills produced significantly more echolalic utterances in spontaneous speech than those children whose receptive skills were more age-appropriate. Autistic children with better receptive language ability produced fewer echolalic utterances and a higher proportion of mitigated echolalia (e.g., echo plus affirmation or denial), independent of CA. Other studies note a strong association between syntactic ability and performance on theory-of-mind tasks among children with autism (Tager-Flusberg, 1992; Tager-Flusberg & Sullivan, 1994). In a recent review of the evidence, Happe (1995) points out that verbal skills are relevant to performance on theory-of-mind tasks, but that the verbal age required for success in autism (MA 9 years) is much higher than in typically developing children (MA 4 years).

Notwithstanding this association between receptive language and theory-of-mind tasks, there is some evidence that pragmatic function can be separated from morphosyntactic form, especially in language use. In spontaneous question asking (Tager-Flusberg, 1994), children with autism produced questions that were formally identical to those produced by MLU-matched children with DS, but used them to serve quite different communicative functions. The children with DS asked far more questions seeking external information, agreement, and clarification, whereas the children with autism used questions primarily to seek attention or assistance, including some, such as "Do I need help?" that were "distinctly odd." Whereas children with DS demonstrated awareness of other minds and opinions, the children with autism were expressing their own needs.

Further evidence of a split between intact syntactic function and impaired pragmatic skill derives from a study by Thurber and Tager-Flusberg (1993) investigating story narratives produced by autistic (IQ 58; CA 12.1), mentally retarded (IQ 60; CA 11, 3) and normal (CA 3, 9) children matched on verbal and mental age (PPVT-R 6,8 to 7,3). When asked to tell the story depicted in a wordless picture book, the stories of the children with autism were significantly less complex than those of the other children, suggesting minimal investment of effort as well as deficits in social and cognitive functioning. And yet children with autism displayed considerable sensitivity to syntax, producing significantly fewer nongrammatical pauses; even then, their nongrammatical pausing was not random, but was correlated with measures of story length and complexity. This sensitivity to syntax is also evident in the frequency of repairs and grammatical pausing, which were similar across the three groups. The authors suggested that autism involves a specific impairment in pragmatics (secondary to social cognition deficits), but not a specific impairment in syntax or phonology (cf. Paul et al., 1987; Tager-Flusberg, 1981, 1989). It is generally agreed that persons with autism have pronounced pragmatic deficits, but it is not yet entirely clear whether to attribute them entirely to social cognitive deficits. Further investigation is necessary to better disentangle pragmatics and syntax.

Pragmatic skills in persons with fragile X syndrome

A second group with unusual pragmatics are males with fragile X syndrome, now recognized as the most common inherited form of MR (for an overview, see Dykens, Hodapp, & Leckman, 1984). Although level of cognitive impairment can range from severe to borderline or even low-normal, it is generally agreed that language deficits are present in all affected males (Hagerman & Sobesky, 1989) According to McEvoy (1992), severity of delay can range from an entire absence of speech to a more subtle communication difficulty. These authors characterize the speech of high functioning males as "cluttered," including dysfluencies, rapid speech rate, frequent tangential remarks, and poor topic maintenance. Moderately and severely retarded males speak in phrases with a characteristic pattern that has been described as jocular, litany-like, or staccato.

When compared to males with DS of comparable age and levels of cognitive impairment, males with fra(X) manifested significantly more jargon, perseveration, and echolalia; were more inappropriate and tangential; and talked to themselves more than the males with DS (Wolf-Schein et al., 1987). Whereas the males with DS used appropriate referential gestures and facial and head movements, the males with fra(X) did not use referential gestures and facial movements to further communicative intent.

of 14 children with spina bifida, who were not distinguishable from the others in respect to memory, vocabulary, or verbal output; Stough et al. suggest that the syndrome stems from dysfunctioning brain structures thought to govern executive self-regulating and self-correcting behavior. It would seem that pragmatics, more so than morphosyntax, is dependent on general intelligence and executive function.

In summary, children with WS (and some cases of spina bifida) are highly social and have an impressive mastery of pragmatic skills such as are captured in intonation patterns and common conversational gambits. At the same time, they appear to lack the ability to apply these skills in a manner appropriate to their listener. Although it remains for comparisons to be made with normal children matched on MA (or language level), these observations may support the hypothesis of Rosenberg and Abbeduto (1993) that children will not rise above their cognitive level in pragmatic skill.

Semantics

Semantics refers to the meanings encoded within language at both the sentence and the word level. Although most studies of MR language frequently include a standardized measure of receptive vocabulary, few make semantics their primary focus. From these studies, it is now clear that persons with MR apply normal strategies for comprehending sentences and organizing their lexicon, and often develop extensive vocabularies. Common areas of weakness include abstract vocabulary, relational terms such as *before/after*, and idioms, as well as more in-depth knowledge about verbs. As one would expect, semantic knowledge is highly correlated with, and sometimes serves as a measure of, overall cognitive function. Cognition and semantics can, however, be dissociated, as is made especially salient in recent comparisons (e.g., Bellugi et al., 1990) of adolescents with DS and WS matched on MA and overall IQ (FSIQ 50, CA 15 years). In adolescents with WS, receptive vocabulary age (8.4 years) exceeded MA expectations: in the adolescents with DS (vocabulary age 5.3 years), it was uniformly below MA expectations. Differences in semantic fluency were even more striking. When asked to generate names of animals, the group with WS listed an average of 26.8 items over trials, compared to a mean of 15.8 for those with DS. Adolescents with DS produced high-frequency, typical names such as *cat, pig,* and *dog;* those with WS generated names such as *unicorn, tyrandon, brontosaurus, yak, ibex,* and so on. In short, the evidence for spared semantics in WS cuts across both receptive and productive vocabulary knowledge.

Both semantics and morphosyntactic function are spared in WS, but evidence from other subgroups suggests that these too can be dissociated.

For example, despite being low relative to MA expectations, receptive vocabulary in persons with DS often exceeds morphosyntactic function (e.g., Chapman, 1993; Fowler, 1990; Miller & Chapman, 1984). This dissociation will be further discussed in the section on syntax.

Especially interesting are recent studies suggesting that specific deficits in other components of language or cognition will be reflected within the lexical system. For example, persons with autism show specific deficits in intentional terms; syntactically impaired persons with DS have underspecified verbs, and phonologically impaired persons with fra(X) have difficulties with lexical retrieval.

Evidence that semantics is acquired, represented, and processed in normal fashion

There is, as in other aspects of linguistic processing, a sizable literature suggesting that persons with MR develop, represent, and apply semantic knowledge in much the same way as typically developing children at younger ages (for recent reviews, see Mervis & Bertrand, 1993; Rosenberg & Abbeduto, 1993). In particular, persons with MR acquire early vocabulary and semantic relations in the same order as do younger typically developing children, (e.g., Cardoso-Martins, Mervis, & Mervis, 1985; Duchan & Erickson, 1976; Fowler, Gelman, & Gleitman, 1994; Mervis, 1987); apply similar strategies when acquiring novel lexical items (e.g., Chapman, Raining-Bird, & Schwartz, 1990; Mervis & Bertrand, 1993); and show similar effects of prototypicality in lexical tasks (e.g., Tager-Flusberg, 1985a, 1985b). In other research reviewed by Rosenberg and Abbeduto (1993), persons with MR also show evidence of normal semantic priming effects, such that when asked to name two pictures, they are faster at naming the second object when it was in the same category as the first (*cat, horse*) than when it was in a different category (*cup, horse*).

Persons with MR also apply typical semantic strategies in sentence comprehension. In two separate studies, adolescents with DS or unspecified MR were more accurate in understanding semantically plausible than implausible constructions, with semantic sensitivity exceeding syntactic sensitivity in comparison to younger language-matched samples (Dewart, 1979; Fowler, 1984). Further evidence for normal semantic strategies derives from a study by Bilsky, Walker, and Sakales (1983) comparing adolescents with mild MR (CA 16 years, IQ 62) with typically developing 10-year-olds matched on MA. Although sentence recall performance was relatively poor in the adolescents with MR, inferential processes were similar across the two groups, each being as sensitive to particular cues (e.g., *horse*) as they were to general cues (e.g., *animal*) in retrieving target sentences.

These normal semantic processes in mental retardation coexist with obvious limitations in the accuracy and efficiency of inferential processing. Young adults with MR, for example, are significantly less able than CA- or MA-matched controls to recall the final word of agent-action-object sentences presented at 3-second intervals, when retrieval is cued with the subject-verb (Merrill & Bilsky, 1990). When, however, there is only a 1-second pause between sentences, the three groups performed equivalently, suggesting that automatic semantic processing is comparable across groups and that differences at the 3-second interval might arise from strategic and effortful processes lacking in the group with MR. On the other hand, participants with MR performed as well as the comparison groups when sentences were originally presented with pictures depicting their meaning; the pictures apparently aided semantic retrieval (Merrill & Jackson, 1992). Young adults with MR were also significantly aided in recall (and in speed of sentence verification) when the words in the sentences were strongly related (e.g., *hunter shot rabbit* versus *photographer chased rabbit*) (Merrill & Jackson, 1992). In summary, despite slower and less strategic retrieval processes, persons with MR seem to encode semantic information in much the same way as persons without MR.

Some specific effects of mental retardation on lexical knowledge

Investigators have recently moved beyond sole reliance on omnibus semantic measures such as the PPVT-R (Dunn & Dunn, 1981) to understand more specific effects of MR on lexical development. For example, Fazio, Johnston, and Brandl (1993) assessed lexical knowledge in school-age children with mild MR, using both the PPVT-R, which measures familiarity with labels for objects and activities, and the Boehm Test of Basic Concepts (Boehm, 1971), which focuses on relational terms such as *nearest* or *between*. Performance on a general cognitive measure, the Columbia Mental Maturity Scale (Burgemeister, Blum, & Lorge, 1972) was strongly related to the Boehm (r = .72***), but not related to the PPVT-R (r = .27), suggesting that MR exerts a more specific effect on abstract relational terms than on absolute number of labels recognized. Similarly, Natsopoulos and Xeromeritou (1988) found that schoolchildren with MR (VIQ 63) were significantly less able to comprehend the abstract semantic relations encoded by *before* and *after* than were typically developing children (CA 4; 3) matched on MA.[1]

Detailed study of semantic skills in WS has also yielded interesting splits in knowledge. Whereas adolescents with WS obtain far higher scores on receptive vocabulary measures and generate far more labels in semantic fluency tasks than adolescents with DS, the groups perform equivalently when asked to define terms on the WISC-R vocabulary subtest. Those with

WS provided lots of situational or anecdotal information in attempting definitions but were no more able to identify criterial features than persons with DS (Bellugi et al., 1993). Similarly, despite an extensive vocabulary for animals, adults with WS have no more understanding of such biological concepts as "alive," "animism," or "people-as-one-animal-among-many" than do 6-year-olds at a preoperational stage of cognitive development (Johnson & Carey, 1995). And yet, on unusual vocabulary items that do not require conceptual change, the adults with WS performed as well as typically developing 9-year-olds matched for MA. According to Johnson and Carey, this discrepancy between preoperational conceptual knowledge and advanced vocabulary results in "large, adult-like lexicons mapped onto child-like concepts."

The semantics of verbs is also complex. Whereas recognizing actions depicted in the PPVT-R correlates well with MA, knowledge about how verbs assign argument structure is more closely associated with syntactic knowledge. As discussed in detail below, Naigles, Fowler, and Helm (1995) observed schoolchildren with DS (MA 6 years) who, like much younger preschoolers, were largely insensitive to grammatical constraints specific to verbs they can recognize. According to Cromer (1987), where persons with MR do have knowledge about syntactic constraints on specific verbs and adjectives, that knowledge is correlated with the frequency with which a given verb is used, suggesting this knowledge may be acquired verb-by-verb; in contrast, verb knowledge in young children without MR is unrelated to verb frequency.

Finally, specific semantic deficits are frequently observed in persons with autism, including curious use of pronouns (I/you) and difficulty with other terms involving perspective taking. A different kind of semantic weakness is evident in fragile X syndrome, relating more to retrieval processes. These two phenomena are discussed in the sections below.

Isolated semantic deficits in autism?

In an effort to better document clinical reports that children with autism tend to confuse personal pronouns, Lee, Hobson, and Chiat (1994) compared autistic teenagers with MR (MA 4–6 years) with typically developing children matched on CA and MA, using a series of tasks requiring the comprehension and production of "I," "you," and "me." Against expectations, there were few instances of pronoun reversal within the experimental paradigm and all participants demonstrated accurate comprehension. And yet, teachers (rating the children independently) reported that 17 of the 25 participants with autism reversed pronouns on occasion, whereas no child without autism was reported as having reversed pronouns. Consistent with this split between performance in and out of

experimental conditions, the authors commented on a young man who, after succeeding on all experimental measures, ended the visit with, "Thank you for coming, Tony" (his own name). In spontaneous speech samples collected from young autistic children, Tager-Flusberg (1989) reports that pronoun-reversal errors comprised about 12% of pronoun usage, but never occurred in the transcripts of nonautistic youngsters with DS.

Consistent with a lack of insight into another's mental state, young autistic children make significantly fewer references to cognitive mental states in everyday discourse than do language-matched youngsters with DS, despite comparable usage of terms referring to (the speaker's own) perception, desire, and emotion (Tager-Flusberg, 1992). Autistic adolescents also used few mental-state terms (22%) in a picture-sequencing task that served to evoke psychological-intentional terms in children with DS (of lower MA) and in typically developing preschoolers (Baron-Cohen, Leslie, & Frith, 1986). In contrast, when the sequences could be understood in terms of causal-mechanical or simply descriptive-behavioral criteria, the autistic children produced appropriate causal and behavioral language between 78% and 95% of the time.

It has been more difficult to document parallel deficits in semantic comprehension. Although children with autism (CA 8 years) display less understanding of emotional adjectives (e.g., *mean*) than CA-matched control groups (one with typical development, one with schizophrenia), they perform as well as typically developing children matched on MA (Van Lancker, Cornelius, and Needleman, 1991). Ignoring the finding that the autistic group was as accurate as CA-matched comparison groups on nonemotional adjectives (e.g., *old*), the authors attributed abnormal performance on emotional adjectives to language delay. Though it is clear that poor performance on mental-state tasks cannot be attributed solely to language delay (e.g., Leslie & Frith, 1988), performance on mental-state tasks is highly correlated with measures of syntactic (though not vocabulary) comprehension in autistic subjects (CA 7–22 years, IQ 68–72), suggesting close connections between linguistic ability and theory of mind (Tager-Flusberg, 1994).

Choosing from several possible explanations for this association, Tager-Flusberg (1993) suggests that some autistic individuals may use their knowledge of language to bootstrap their understanding of mental states. In this regard, it is interesting to note earlier reports stressing the significance of language for the social development of children with autism. Note, for example, Rutter's (1978) pronouncement that autistic children who develop useful language by 5 years of age have a much better prognosis for social adjustment than those who have developed little or no language.

Lexical retrieval in fragile X syndrome

Even when receptive vocabulary is consistent with MA, the ability to retrieve semantic information accurately and efficiently may not be. Particularly severe lexical retrieval difficulties have been noted in persons with fra(X). When asked to complete sentences whose meanings were constrained (*Meat is cut with . . .*) or unconstrained (e.g., *Grownups think about . . .*), males with fra(X) (CA 5 years to adult; Vineland communication age 4.25 years) committed significantly more semantic errors (*fur grows on . . . trees*) than typically developing 4-year-olds. The groups did not differ in number of syntactic errors, vague responses, or failure to respond. The males with fra(X) were also disproportionately hampered by reduction in contextual constraint (1.9 errors in constrained condition; 4.5 in unconstrained condition) (Sudhalter, Maranion, & Brooks, 1992).

Sudhalter et al. (1992) hypothesize that these semantic retrieval problems may explain the extreme levels of perseverative language observed in fra(X) speech. However, the fact that affected individuals suffer multiple language impairments makes it difficult to distinguish semantic difficulties from pragmatic or phonological weaknesses. In a further attempt to tease apart some of these multiple factors, Spinelli, Oliveria Rocha, Giacheti, and Richieri-Costa (1995) made a detailed study of the nature of speech errors in spontaneous dialogue. Word-finding difficulty (defined as impaired fluency with deliberate attempts to search for the word) was clearly indicated in half of their sample (two females, three males), but was not evident in the remaining three males, all of whom presented much more severe verbal dyspraxia (inconsistent articulatory errors, inappropriate stress and intonation). These results suggest it may be possible to separate semantic from phonological errors, but further research is clearly required to better understand (and remediate) the complex language impairment in fra(X).

Summary

The smallish body of research on semantics in persons with MR suggests a complex system. Not only does comprehension of sentences involve the intersection of syntax and semantics, but lexical knowledge varies depending on which and how items are assessed. Within the lexicon, performance on individual terms depends crucially on how they relate to other aspects of linguistic or cognitive function. People with autism display isolated deficits in producing (if not necessarily understanding) intentional terms; people with DS show difficulties with grammatical aspects of verbs; people with WS have difficulty with concepts dependent on cognitive reorganization. In persons with WS, semantic production is closely

tied to receptive vocabulary; in other subgroups, production is distinct from comprehension, potentially sharing more resources with phonology.

Morphosyntactic function

Research over the last decade has extended and confirmed a large body of prior research demonstrating that morphosyntactic development in persons with MR largely parallels that observed in typically developing children, though often stopping short of full mastery. In addition, detailed case studies of sophisticated grammatical function in the face of severely impaired general cognitive function has suggested that later morphosyntactic development is largely autonomous from other aspects of cognition (Cromer, 1994; Curtiss, 1988a, 1988b; Rondal, 1994a, 1994b Yamada, 1990). Finally, evidence of dramatic variation in syntactic skill among similar-IQ persons with MR makes it increasingly possible to speculate about what (if not general IQ) underlies these individual differences. Why does one person with an IQ of 50 master the grammar of English while another stalls at early preschool levels? Several explanations have been advanced for why syntax may be differentially impaired or spared in individuals of comparable intelligence.

Impact of cognitive impairment on syntax: Delay without deviance

Across a large number of studies, syntactic function in persons with MR, whatever the source or extent of the retardation, looks like syntactic function in younger (sometimes much younger) typically developing children (e.g., Fowler, 1990). That is, when children with MR are compared with younger typically developing children, they use sentences similar in kind (if not in complexity) and make similar errors. Complexity increases in a similar fashion in both groups, with no evidence for deviant constructions in MR children not found also in typically developing children. In an early demonstration of these phenomena, Lackner (1968) wrote grammars to describe the language "competence" of five retarded children suffering from encephalopathy (CA 6 to 14 years., MA 2;3 to 8;10 years). These grammars were based on an extensive data base, including 1,000 spontaneous utterances per child, supplemented with probes for specific structures using elicited repetition and comprehension procedures. Not only was development normal and grammars systematic in all respects, but MA predicted syntactic complexity: Typically developing children individually matched on MA could comprehend sentences constructed from the grammar of the child(ren) with MR at or below their own MA but could not comprehend sentences from higher MA children.

Although few subsequent studies have supported Lackner's assertion that MA is a good predictor of linguistic complexity, many studies have replicated his findings regarding order of complexity and regarding normal strategies for production and comprehension (e.g., Cromer, 1987; Kernan, 1990; Natsopoulos & Xeromeritou, 1990; see Fowler, 1990, and Rosenberg & Abbeduto, 1993, for recent reviews). For example, although it is logically possible for length to outstrip syntactic complexity, mean utterance length (MLU) is tightly associated with sentence complexity, up until MLU 4, in most groups with MR (e.g., Kamhi & Johnston, 1982; Scarborough, Rescorla, Tager-Flusberg, Fowler, & Sudhalter 1991). In males with fra(X), the correlation between MLU and grammatical complexity is .88, much like the normal case (r = .96) (Sudhalter et al., 1991). In longitudinal research too (e.g., Fowler, 1984; Fowler, Gelman, & Gleitman, 1994; Marcell, Croen, Mansker, & Sizemore, 1994; Tager-Flusberg et al., 1990), the order of mastery of syntactic structures closely parallels the patterns observed in the normal case. It has been argued that this nondeviant development is consistent with a model of language acquisition that is heavily constrained by the brain that is acquiring the language (e.g., Newport, 1990).

In recent years, much of the work on syntax has focused on comprehension, with particular attention to three grammatical constructions: (1) comprehension of active and passive voice constructions; (2) comprehension of relative clause constructions; and (3) sensitivity to verb-dictated assignment of agents to verbs. Early on, Dewart (1979) focused on the strategies brought to bear in interpreting active and passive constructions (*The dog bit/was bit by the cat*). She found that high-functioning children with MR comprehended active sentences as well as MA-matched normal children but performed significantly less well with the passive voice. Dewart attributes this poor performance on passive-voice sentences to an abnormal reliance on word order. In subsequent research involving similar constructions, Bridges and Smith (1984) also found that children with MR performed equivalently to typically developing children matched on MA on actives and worse on passives. However, they observed that overreliance on word order was common in both groups of children, and hence a normal language "stage" rather than a deviant strategy. Similar results were found by Fowler (1984), who presented active and passive sentences in an act-out task to children with DS, and to MLU-matched preschoolers without MR (CA 2 to 3 years.). The two groups did not differ on semantically neutral sentences, but did differ in sensitivity to semantic plausibility. The preschoolers conformed rigidly to word-order constraints (hence failing the passive, and passing the active). The adolescents allowed semantic constraints to supersede word order when in conflict.

Overall, these three studies suggest that language stage is a good predictor of syntactic comprehension strategies, whereas MA is a better predictor of semantic sensitivity.

To further evaluate whether children with MR (CA 8 to 18 years; IQ 67) rely more on word-order strategies than on syntax in sentence interpretation, Natsopoulos and Xeromeritou (1990) examined comprehension of complement clauses embedded into four sentence frames:

1. John asked Mary what groceries to buy
2. John promised Mary to buy groceries
3. John asked Mary to buy groceries
4. John told Mary what groceries to buy

These constructions are especially challenging because the grammatical subject of the complement clause is missing from the surface structure. Although some theorists have suggested that novice speakers will always assign the verb in the complement phrase to the closest noun (i.e., Mary buys the groceries) in accordance with the "minimal distance principle," in this study, the children with MR, and MA-matched groups of children without MR (CA 69 months; VIQ 110; MA 7 years) consistently assigned agent status to the first noun (e.g., John buys the groceries). Both groups were more accurate on types 1 and 2 than on 3 and 4, leading the authors to conclude, like Bridges and Smith (1984), that both groups use syntax to a similar extent.

As mentioned earlier, Cromer (1974) also found that children with MR used comprehension strategies much like those of younger normal children when asked to act out constructions varying in whether the sentence subject is the subject (S-type) or object (O-type) of the embedded verb:

O-types *The duck is easy to bite*
S-types *The duck is glad to bite.*

Focusing on these same constructions, Cromer (1987) tracked development over time in two groups of children (one with mild MR, one without MR) selected for being at an "intermediate" stage of syntactic development. Whereas linguistically "immature" children consistently interpret the sentence subject as the agent of the embedded verb in both O-type and S-type sentences, children who qualify as "intermediate" interpret these sentences in more inconsistent fashions, without achieving full accuracy. In this study, intermediate-level children with MR were just as accurate and consistent on the more difficult O-type constructions as intermediate children without MR; however, the group with MR was significantly less accurate and less consistent on the simpler S-type constructions. Whereas the errors of the children with MR were highly correlated

with word frequency ($r = .74$), inconsistencies were unrelated to word frequency in children without MR ($r = .05$).

Further research on the grammatical marking of individual lexical items was carried out by Naigles et al. (1995), focusing on children's knowledge of the fact that some verbs (e.g., *bring*) are obligatorily transitive, whereas others (e.g., *fall*) are intransitive. In typical development, children begin with the bias that those verbs which occur in transitive frames (*I bring a book*) require an object; whereas those in intransitive frames (*I fell*) disallow objects; only over considerable time and experience do they come to acquire knowledge specific to individual verbs. To determine whether children with DS rely more on general syntactic principles (frame compliance) consistent with their morphosyntactic level, or verb-specific knowledge (verb compliance) consistent with their verbal MA, Naigles et al. presented familiar verbs in novel frames (e.g., the *lion fell the giraffe*). Despite receptive vocabulary levels of 5;4 years, schoolchildren with DS (CA 9 to 11;8 years) were almost entirely swayed by the sentence structure in which the verb was placed, using comprehension strategies common in young preschoolers, interpreting the sentence as "the lion caused the giraffe to fall" rather than "the lion fell [to] the giraffe." Adolescents with DS (MA 6;6, CA 12 to 17;11 years), like typical 3- and 4-year-olds, relied somewhat more on verb-specific information, but only in the simplest of the syntactic frames presented.

In sum, recent studies of morphosyntactic function converge to suggest that persons with MR are systematic in their grammatical knowledge, follow the normal course of development, show similar order of difficulty, and often can handle only limited levels of syntactic complexity.

The basis of morphosyntactic deficits

One of the most striking observations about MR language is the tremendous variability in linguistic function within and across subgroups of persons with MR that cannot be attributed to general cognitive factors. On one hand, as reviewed in Rosenberg and Abbeduto (1993), many adults with mild MR speak in syntactically complex sentences, with appropriate use of grammatical morphology, suggesting that it is certainly possible to achieve ultimate levels of grammatical knowledge with limited cognition. Full mastery of morphosyntactic function (after initial delayed development) also seems to be the case in more severely impaired persons with WS (e.g., Bellugi, Bihrle, Neville, Jernigan, & Doherty, 1993), in some rare chromosomal disorders (e.g., Borghgraef, Fryns, & Van der Berghe, 1988), and in several other well-studied (though ill-understood) cases of organic pathology paired with exceptional language development (e.g., Curtiss, 1988a, 1988b). On the other hand, it is also clear (and, I would

argue, even more surprising) that other adults of equivalent cognitive status acquire only limited levels of morphosyntactic function, as is often reported for persons with DS or fra(X) syndrome (e.g., Paul et al., 1987; Sudhalter et al., 1992). As noted by Abbeduto et al. (1989), beyond an MA level of 5 years, the relationship between language and cognition is "heterogeneous"; Rao and Srinivas (1988) used the term "varied" to describe the lack of correspondence between speech and language delay and severity of MR in their study of 300 disabled children in India.

What is most provocative of all are extreme variations within a single well-understood syndrome. For example, although grammatical levels are frequently low in DS, there are also cases of exceptional language (Fowler, 1995; Rondal, 1994). In autism too, well-developed grammar is possible but far less common than a total lack of language (Tager-Flusberg, 1994, n. 1). This variability precludes any simple story, but it is just this selective sparing or impairment of morphosyntactic function that provides a window into the cognitive, linguistic, and neurological bases of individual differences in language function, and to the separability and interdependence among language components.

Several distinct hypotheses about morphosyntactic variability in syntactic development have been generated, not only through research on persons with MR, but also through study of children with SLI or dyslexia. The first three hypotheses introduced below are more descriptive than explanatory; these attribute morphosyntactic deficits to inconsistent application of rules, critical period factors, or a specific morphemic deficit. Two additional applications deserve more extensive discussion: memory, because it is so frequently correlated with language in MR; and phonology, because it could simultaneously account for both grammatical and memory errors.

Inconsistent application of rules. Early researchers (e.g., Lackner, 1968) chose to ignore inconsistent application of linguistic rules as masking true linguistic "competence." However, the observation that persons with MR continue to make errors on long acquired structures is striking. Recall, for example, that children studied by Cromer (1987) were significantly more inconsistent on the earlier acquired constructions than language-matched controls. Similarly, adolescents with DS studied by Fowler et al. (1994) were producing later emerging grammatical morphemes (e.g., verbal auxiliaries), while still erring on those morphemes which appeared first (e.g., plural). This pattern was confirmed both cross-sectionally and longitudinally. Because inconsistent rule learning/application is probably an important descriptor of MR language, and resonates well with clinical reports, it deserves further study in its own right.

Critical period factors. Curiously, many adolescents and adults with DS fail to master morphosyntactic skill that is typically acquired by 3 or 4 years of age, well below MA expectations. One possible explanation, first proposed by Lenneberg (1967), is that language learning dramatically slows after a biologically imposed shutdown of the critical period for language acquisition. Recent estimates, looking at CA effects on first and second language learning (including sign language), place the end of this hypothetical critical period at approximately 7 or 8 years of age (Newport, 1990), emphasizing that the shutdown is not absolute. The limited longitudinal data currently available for children with MR suggest relatively rapid growth in the preschool years, followed by more limited growth in the school-aged years and beyond (Dykens, Hodapp, & Evans, 1994; Fowler, 1988; Fowler et al., 1994; Miller, 1988; Tager-Flusberg et al., 1990). Consistent with a slowdown rather than shutdown, Fowler (1988) observed a modest increase in syntactic comprehension and production during late adolescence among persons with DS (see also Chapman, 1993; Marcell et al., 1994). Also consistent with a critical period explanation is the observation in cross-sectional studies that, relative to MA, morphosyntactic deficits often become more pronounced with increasing CA.

Newport (1990) raises the possibility that these critical period phenomena may stem from changes in overall cognitive function: Whereas young children are forced to analyze utterances to accommodate their cognitive limitations, older children are more likely to store unanalyzed utterances. Such an explanation cannot, however, account for the slowdown in children with MR, who, by those standards should be open to language learning for many more years. In a somewhat different approach to critical period phenomena, Locke (1994) has argued that impoverished language results when the child is deprived of a full data base (by either environmental or cognitive factors) during what he refers to as a "critical period for activation of species-typical linguistic mechanisms" (p. 37). Beyond that time, the child can continue to acquire "utterances," which Locke describes as a right-brain function, but these will not undergo the kind of analysis that characterizes early language learning.

Clearly, more definitive data are needed to better evaluate these hypotheses, looking beyond the relatively well-studied case of DS. The growing disparity between MA and language level even in children without DS is of interest (e.g., Abbeduto et al., 1989), but it would also be worthwhile to learn just *when* highly verbal children with DS, or WS, or autism achieved their impressive skills. Needing further investigation are clinical accounts of children with rarer forms of MR, who reportedly have language and speech difficulties that are pronounced around 4–6 years of age but disappear within a few years (e.g., Borghgraef et al., 1988; Tilstra,

Grove, Spencer, Norwood, & Pagon, 1993). It would also be of great interest to examine susceptibility to language therapy as a function of CA and language status.

Specific morphosyntactic deficit. Gopnik (1990) has speculated that some cases of specific language impairment may stem from a (genetically transmitted) insensitivity to grammatical features (plural, gender, tense). As evidence, she cites data from an extended family of affected individuals, none of whom produced morphological overgeneralizations. Unfortunately the evidence for such an isolated deficit is not well substantiated: Other investigators familiar with the family studied by Gopnik report both that some grammatical morphemes *are* acquired and that the deficits extend well beyond grammatical morphemes to affect other aspects of syntax, semantic naming, phonological memory, and receptive vocabulary (Fletcher, 1990; Vargha-Khadem & Passingham, 1990).

Making a somewhat different hypothesis about specific syntactic deficits, Clahsen and colleagues (Clahsen, 1989; Clahsen, Rothweiler, Woest, & Marcus, 1992) point to particular problems with establishing agreement relations in grammar. According to that view, plurals (which are a semantic marker not dependent on agreement within the sentence) should not be problematic for language-impaired children, despite their status as a syntactic-semantic feature and despite their low acoustic salience. In contrast, the theory would anticipate difficulty with verbal auxiliary markers, gender agreement within noun phrases, and subject-verb agreement. Clahsen reports just such a pattern in German-speaking children with SLI, suggesting they do not have a general morphological deficit. At the same time, the results cannot be explained on the basis of a simple phonological account according to which all elements of low acoustic salience would be omitted.

Memory difficulties. Difficulty with verbal working memory has long been hypothesized to play an important role in language difficulties in persons with MR (e.g., Cromer, 1974; Ellis, 1970; Graham, 1974; Hulme & MacKenzie, 1992). Some investigators, however, have rejected this explanation on the grounds that they failed to find a correlation between digit span and syntactic comprehension (e.g., Dewart, 1979; Natsopoulos & Xeromeritou, 1990) or because the memory levels attained by hyperverbal individuals appear to be limited in some absolute sense (e.g., Cromer, 1994; Rondal, 1994). These studies have flaws, however, and the hypothesis has recently been revived (e.g., Hulme & MacKenzie, 1992), aided by more sensitive memory measures, a more solid theoretical foundation, and related research on children with SLI or dyslexia. Notably, in research on children with SLI and dyslexia, Gathercole and Baddeley

(1990) observed that phonological memory, indexed by the ability to accurately repeat back multisyllabic pseudowords, was the single most powerful predictor of language deficits among normal-IQ children.

Among persons with MR, it is interesting that those individuals whose morphosyntax is "spared" tend also to have relatively intact verbal working memory. This is true not only in comparisons across syndromes (e.g., Crisco, Dobbs, & Mulhern, 1988; Hodapp et al., 1992; Wang & Bellugi, 1994), but may also explain some individual variation within syndromes (Fowler, 1995; Marcell, Croen, & Sewell, 1990). Both Rondal (1995) and Cromer (1994) express surprise that their hyperverbal adults with MR manage to acquire complex syntax with a digit span as low as 4, and yet it should be kept in mind that a digit span of 4 is the norm for 3- and 4-year-olds with full linguistic competence (see Racette, 1993, for relevant data). In her study of 33 young adults with DS, Fowler (1995) found that only those persons with digit spans of 4 or more achieve complex syntax. In short, a little memory may go a long way, but more severe memory impairment may prove to be an important obstacle to syntactic acquisition.[5]

Recent observations about memory derived from an in-depth study of children with moderate levels of MR ($n = 55$ with DS, $n = 55$ without DS) suggest striking parallels between memory development and morphosyntactic development. In that study by MacKenzie and Hulme (1987), digit span (like morphosyntax in other studies) was only modestly correlated with MA in the group with DS ($r = .41$) and in the group without DS ($r = .43$). There was a significantly higher correlation between MA and STM ($r = .71$) in typically developing children (CA 4 to 8 years) of comparable MA (6 years). In both groups, digit span (like language) was generally, though not always, below MA expectations. As MA increased, so did the lag between MA and memory span; MA increased over time, but there were only minimal gains in digit span in either of the groups with MR, in dramatic contrast to gains made in typically developing children. In the group with DS followed over time ($n = 8$), the digit span began at 3.1; five years later, when subjects were aged 14 to 19 years, the mean span had increased only to 3.6, with only two subjects able to reliably recall 4 digits in order. MA scores in the mixed etiology group ($n = 8$) increased at the same rate as in the group with DS, with mean MA increasing by 16 months over 5 years. In that group, mean span increased from 3.5 to 4.1 digits; one subject finished with a span of 6 digits, 3 with a span of 4 digits, and the remaining 4 could recall 3 digits. In short, as is true for morphosyntax, relatively few cases of moderate to severe retardation exist in the presence of comparatively well-preserved short-term memory performance.

Given a number of reasons to believe that memory plays an important

role in syntactic development among persons with MR, it becomes important to understand the source of the memory difficulties. One conclusion on which most investigators agree is that the memory deficits that appear to be related to language are specifically verbal. In DS, for example, severe limitations in verbal short-term memory deficits are in marked contrast to relatively intact skills in visual or motor sequencing, ruling out a global deficit in sequential processing (Bilovsky and Share, 1965; for supporting data, see Doherty, 1993; Marcell & Armstrong, 1982, Marcell & Weeks, 1988; Pueschel, 1988). Whereas typically developing children (and adolescents with WS) display an advantage for retaining verbal over visuospatial stimuli, this pattern is reversed in persons with DS (Fowler, 1995; Wang & Bellugi, 1994). That the difficulty is verbal, rather than auditory or articulatory, derives from observations that the deficits in DS are evident whenever verbal coding is involved, independently of whether the stimuli (e.g., letters) were presented visually or orally (e.g., Varnhagen et al., 1987), or whether the response to be made required speaking or only pointing (Marcell & Weeks, 1988).

One account of individual differences in verbal working memory focuses on speed of articulation, which sets a limit on the amount of information that can be stored and rehearsed within an articulatory loop (Gathercole & Baddeley, 1990). Although it is certainly true that persons with DS do have slowed articulation, and even that their rate of articulation is associated with verbal memory scores (e.g., Racette, 1993), perhaps more striking is a frequent failure to rehearse verbally at all (e.g., Comblain, in press; Ellis, 1970; Hulme & MacKenzie, 1992; see Broadley, MacDonald, & Buckley, 1995, for contradictory findings). This failure, too, seems to be specifically verbal, as persons with MR who fail to use verbal rehearsal strategies will use nonverbal strategies such as pointing to aid memory (Fletcher & Bray, 1995). Investigators have advocated training (e.g., Hulme & MacKenzie, 1992), but attempts to train rehearsal strategies have not yet proven very successful or long-lasting (e.g., Comblain, in press). To make a convincing case that verbal rehearsal underlies memory deficits, and hence syntax comprehension and production, it will be necessary to demonstrate that rehearsal in strategies leads to improved language. This remains to be done, convincingly, in any population.

A somewhat distinct account of verbal memory deficits attributes individual differences to variation in speed of lexical storage and retrieval (e.g., Varnhagen et al., 1987). Although they also failed to find evidence of verbal rehearsal strategies, Varnhagen et al. focused on severe deficits in the speed of lexical retrieval from a long-term store in persons with DS, reporting significant correlations between retrieval speed and memory span not found in non-MR children. Their observation is consistent with

recent accounts of verbal memory that depend importantly on lexical access (Gathercole & Adams, 1993; Hulme, Maughan, & Brown, 1991).

Whatever the precise mechanism, it seems clear that individual differences in short-term "phonological" memory depend importantly on some aspect of phonological processing – be it encoding of information into a lexical store, rehearsing this information in an articulatory loop, or retrieving this phonological information rapidly and efficiently. For this reason, there is considerable overlap between attributing syntactic problems to a memory problem and attributing them to a phonological problem, as discussed next.

Phonological/perception deficit. In addition to the role that phonology plays in memory, there are a number of reasons to think phonological variation also contributes to individual differences in syntactic skill. For one thing, consistent with Gleitman & Wanner's (1982) phonological salience hypothesis, the very markers that are most often omitted in immature speech, and about which agreement relations must be inferred, are just those that are acoustically nonsalient. At the same time, it is important to keep in mind that phonological difficulties are highly prevalent in the language-delayed population (e.g., Leonard, McGregor, and Allen, 1992), just as language problems are highly prevalent in children first diagnosed for phonological impairments (Shriberg & Kwiatkowski, 1988). Arguing that specific language impairment may have its roots in more basic phonological skill, Leonard et al. (1992) found that even 4- and 5-year-olds with SLI who produced appropriate phonemic contrasts in spontaneous speech were less able to discriminate such contrasts as *das/dash*, *ba/da*, or *dabiba/dabuba* than typically developing children matched on CA. Conversely, unexpected strengths in syntax often co-occur with well-developed phonology, as is true in persons with WS and other cases of exceptional language recently discussed in the literature (e.g., Cromer, 1994; Curtiss, 1988a, 1988b; Rondal, 1994a, 1994b).

In evaluating a phonological deficit hypothesis, it is critical that we come to some consistent agreement regarding what qualifies as a "phonological" deficit. Is, for example, the hypothesis invalidated by reports that syntactic skill can coexist with marked articulatory deficits described by Lebrun and Van Borsel (1991)? And how are we to interpret reports that children with Prader-Willi syndrome uniformly display marked deficits in articulation and morphology, but only one-half of the sample present clear evidence for syntactic deficits (Kleppe, Katayama, Shipley, & Foushee, 1990)? Clearly, to ascertain whether phonological and syntactic skills are associated will depend on well-defined measures of what is meant by morphosyntax (separate from semantics),

as well as on a much cleaner separation of articulation and phonological deficits than is currently available.

In seeking the source of deficits in morphosyntactic function, an important goal for future research is to assess more accurately any syntactic competence that may be masked by processing difficulties, drawing on recent advances in the study of early language development. One possibility is to examine sensitivity to grammaticality, such as has proved effective in looking at morphosyntactic abilities in agrammatic aphasics (e.g., Linebarger, Schwartz, & Saffran, 1983). Although the ability to make grammaticality judgments has previously been restricted to schoolchildren of normal IQ and only high-functioning persons with MR (e.g., Bellugi, Wang, & Jernigan, 1994; Cromer 1994), the serendipitous results of a recent study (Naigles et al., 1994) suggest that it may be possible to assess sensitivity to different grammatical structures in more typical persons with MR. In that study, it became obvious over the course of testing that children (both normal-IQ and those with DS) took significantly longer to begin acting out those sentences which violated constraints on verb argument structure (e.g., *the lion fall the giraffe*) than it did to enact grammatical sentences. Both schoolchildren and adolescents with DS showed this sensitivity to grammatical structure, even though it was less clear in either their comments or their interpretation.

Phonology

Phonological difficulties are commonly reported in descriptions of the language of persons with MR, but few studies have focused on phonology, and most of those have stressed the normalcy of phonological development. There are, however, reasons to believe that phonological skill may be extremely relevant to understanding the entire language profile of the person with MR. For one thing, as discussed above, phonology may be a crucial factor in limiting syntactic development, either through rendering unstressed functors nonsalient or, indirectly, via the role that phonology plays in short-term "phonological" memory. It may also be that what appears to be a semantic production problem (e.g., Spinelli et al., 1995; Sudhalter et al., 1992) may ultimately depend on well-specified phonological representations (see Katz, 1986, for relevant data from persons with reading disability).

Phonological skill also plays a crucial role in determining successful communicative interactions. Even children who test "normal" on a test of articulation, by virtue of being able to produce all phonemic segments in isolated words, may have serious difficulties in intelligibility, resulting perhaps from the stresses placed on the phonological system in fast-moving exchanges with long, complicated utterances (e.g., Crosley &

Dowling, 1989; Paul, Cohen, Breg, Watson, & Herman, 1984). Recognizing the complexity of phonological skill, investigators are augmenting measures of "articulation" with measures of intelligibility, defined as the percentage of words that are interpretable to a listener (e.g., Kent, 1993). Similarly, it is clear from work with other populations that differences in articulation do not account for variability in encoding or retrieving phonological information in memory (see Gathercole & Baddeley, 1989, vis-à-vis children with SLI, or Brady, 1991, vis-à-vis children with reading difficulties). Finally, it must be kept in mind that communicative difficulties may stem from factors quite distinct from structural phonology, as may be the case for the dysfluencies and dyspraxias observed in fra(X) syndrome (Paul et al., 1984). In short, to explore either the causes or consequences of individual differences in phonology, researchers on MR language will have to be very sensitive to assessment issues, building upon the rapidly changing body of research on normally intelligent children with specific language or reading problems.

Phonological weakness in Down syndrome: Marked delay without deviance

It has been observed that persons with DS make far more phonological errors than other persons with MR matched on MA (e.g., Dodd, 1976), and that the errors produced are qualitatively similar to those produced by much younger children matched on language age (MLU) (Smith & Stoel-Gammon, 1983; Stoel-Gammon, 1980). Supporting this view, Van Borsel (1988) observed that the speech errors produced by five Dutch-speaking adolescent girls with DS were nearly identical to the error patterns observed in young normal children, suggesting that these misarticulations result from delay in speech development.

With all this emphasis on "normalcy," only recently have investigators turned their attention to documenting the extent of the difficulties experienced in persons with DS. One hint derives from the observation of Smith and Stoel-Gammon (1983) that children with DS showed a slower rate of improvement over time, lagging further and further behind the language-matched controls on which they were initially matched. In a recent study directing attention to the severity of phonological deficits in DS, Kumin (1994) analyzed data from 937 parent questionnaires regarding intelligibility of their children. Looking across all ages, 58% of the parents answered that their children *frequently* had difficulty making themselves understood and 37% reported that their difficulty occurred sometimes; only 5% reported that their children rarely or never had difficulty in being understood; this was true for at least 85% of the children in each age group. (Kumin notes that nondisabled children typically achieve

100% intelligibility by 4 years of age). Acknowledging that the self-selected nature of the sample may not accurately reflect the true population distribution, these findings are consistent with more informal observations and may suggest that we have underestimated the extent of phonological difficulties in DS. (See Miller, 1987, and Rosenberg & Abbeduto, 1993, for similar sentiments.)

Evidence that phonology is a separable module

There is considerable evidence, from normal and atypical populations, that phonological skill is a separate cognitive module not closely associated with general cognitive function (see Studdert-Kennedy & Mody, 1995, for a recent discussion). This point is well documented in children with SLI (e.g., Rapin et al., 1992), but evidence for such separability within MR is still being gathered. In at least some persons with MR (IQ 50 to 75, CA 5 year, MLU 3.6), phonological development is impaired to the same extent as it is in MLU-matched children with SLI (IQ 100, CA 4 years). Both groups evidence far more phonological processes (e.g., phoneme deletion, simplification, etc.) than typically developing preschoolers matched on MLU (IQ 114, CA 3.6 years) (Klink, Gerstman, Raphael, Schlanger, & Newsome, 1986). Further evidence for specific phonological problems is provided by Lebrun and Van Borsel (1991), reporting on a 17-year-old with DS. Despite fair language comprehension and simple, grammatically correct sentences, her phonological development was poor, with "slurred" articulation and numerous phoneme substitutions and deletions. Prolongations and repetitions of sounds were evident in spontaneous speech as well as in naming and in repetition tasks.

Sources of phonological deficits

There is a growing and contentious literature regarding the source of phonological deficits, much of it turning on the question of whether the deficit is language-specific or whether the difficulties stem from more general difficulties in auditory processing. Despite little explicit data from persons with MR, there are provocative coincidences. Consistent with a general auditory processing view is the observation that persons with DS are not only characterized by phonological difficulties, but by a high incidence of otitis media and hearing loss. In contrast, the hyperverbal children with WS are marked by hyperacusis so extreme that families need to regulate environmental noise to alleviate their child's discomfort (Udwin et al., 1987). Evidence contrary to a general auditory account include Miller, Leddy, Miolo, and Sedey's (1995) finding that rate of early language development in young children with DS is completely independent

of individual differences in hearing. In adults with MR, too, there does not seem to be a significant association between hearing measures and language skill (Marcell, 1992). Finally, a sizable literature suggests that normal-IQ children with SLI or reading disability frequently have speech perception problems, but without accompanying weaknesses in the non-linguistic processing (see Mody, Studdert-Kennedy, and Brady, in press, for a review).

Fortunately, phonological development, perhaps more than other aspects of language, lends itself to remediation. Cholmain (1994) for instance, describes a therapy program to remediate unintelligible speech of six children with DS, using amplification and structured exposure to contrastive values of phonemes. She reports that a major restructuring occurred within short time spans, with increased intelligibility and growth in expressive syntax. Buckley (e.g., 1993), also working with children with DS, has conducted a series of studies using printed language to enhance the spoken representation of speech; this too appears to offer promising results in aiding phonology and syntax. If these success stories can be replicated in well-controlled studies, they would have important implications for our understanding of the underlying bases of language impairment.

Implications

In the last 10 years, research on language in persons with mental retardation has become increasingly analytic, focusing not only on distinct subcomponents of language, but also on well-defined etiologies, aided in identification by rapid progress in biology. Advances in our understanding of other subgroups with language impairment (children with SLI or dyslexia) have been and will continue to be important, both in efforts toward creating an overarching theory of language impairment and in providing tools for assessment.

Research over the last decade has clear and important implications for intervention. First, it makes it ever more essential to assess pragmatics, semantics, morphosyntax, and phonology separately to ascertain the needs of the individual child. Second, within a given language component, it remains important to adopt a developmental approach, working with the child to move through the subsequent stages. Third, the data regarding critical period issues, though still inconclusive as yet, suggest that we should invest considerable resources in enhancing language input and language therapy in the preschool and early elementary years; at the same time, it is clear that therapy should continue well into and beyond adolescence. Furthermore, it is now clear that children should not be denied access to speech services merely because there is not a large discrepancy

between measures of cognitive and linguistic function. Especially as children move beyond the earliest stages of language acquisition, there is sufficient independence between language and cognition that all children who are not yet fully fluent should be given assistance to move them forward. Finally, although each language component carries its own justification for remediation, the research outlined here points to phonology as playing an especially important role in language more generally.

It is also possible that the enhanced understanding of language profiles which characterize specific etiologies will prove helpful for remediation purposes, directing clinicians toward areas of greatest vulnerability and alerting them to look beyond appearances to underlying competencies. It would, however, be a mistake to expect that etiology is decisive regarding ultimate language status. This point is made especially salient in the case of DS, where increasing numbers of young adults are achieving language levels previously undreamed of.

A revolutionary change in the last decade concerns rapid advances in neuroscience: MRI, PET scans, and EEG measures offer outstanding opportunities to test our hypotheses about the cognitive and neurological basis of language impairments, and about the separability of language components. This new technology, if appropriately combined with careful behavioral analyses of the structure of language difficulties in well-defined subgroups with MR, should lead to great advances in the decade ahead.

Notes

1. According to Cantwell and Baker (1987), of children (CA 2–18 years old) brought to a psychiatric clinic, MR was present in 43% of those presenting a language delay ($n = 250$), but in only 13% of cases without clear language delay ($n = 100$). Stevenson and Richman (1976) found mental deficiency in close to half of 3-year-old children with expressive language delays. In a recent Philippine study (Ledesma et al., 1992), MR was evident in 63% of children with language delay. In longitudinal research, Silva, McGee, and Williams (1983) found that over 85% of children with delays in both verbal comprehension and expression at age 3 earned IQs below 77 at age 3, and below 89 at age 7. These results suggest that language deficits may be one manifestation of more general delay.

2. Although children with MR clearly vary in how discrepant language function is from general cognitive function, the utility of such a comparison for intervention has been questioned. In a two-year tracking of the stability of the relationship between language and cognition, Cole, Dale, and Mills (1992) evaluated 125 children enrolled in a special education program (CA 3–7 years, McCarthy IQ 77, PPVT-R 76, TELD 77). Substantial changes in the cognitive–language relation over time led to considerable fluctuations in eligibility for language intervention, which often requires evidence for a preestablished discrepancy between cognitive and linguistic function.

3. Maratsos and Matheny (1994) argue that the data from WS fail to invalidate

the cognition hypothesis on the grounds that typically developing preschoolers who are highly fluent speakers also fail Piagetian concrete operational tests. His point is that such failure may very well stem from memory or attentional demands rather than from a lack of basic cognitive skills. This is possibly, and even probably, true. On the other hand, this disjunction between highly fluent syntax and limited cognitive skills in the typical preschooler could also be turned around to suggest that complex syntactic skill may indeed be independent of such cognitive factors.

4. Curiously, comprehension of idioms (e.g., *hit the books*) does not seem to be differentially affected in MR (Ezell & Goldstein, 1991). Although 9-year-olds with MR (IQ 62) comprehended significantly fewer idioms (17% correct) than 9-year-olds without MR (67% correct), they were just as accurate as typically developing 6-year-olds matched on MA (9% correct); all three groups could select pictures to match literal meanings, and the youngest children were almost exclusively literal. One might question whether the idioms acquired (*break my heart, hit the sack, get carried away*) were acquired as unanalyzed wholes, and hence much like referential vocabulary generally. Further intervention work by Ezell and Goldstein (1992) suggests that children with MR can be taught literal meaning, essentially by monitoring for inappropriate meaning.

5. Beyond an MA of 4 or 5, digit-span scores typically depend not only on phonological memory but also on attentional factors. Digit span alone should not be considered the best measure (for discussion see Brady, 1991; Gathercole & Baddeley, 1989).

References

Abbeduto, L., Davies, B., & Furman, L. (1988). The development of speech act comprehension in mentally retarded individuals and nonretarded children. *Child Development, 59,* 1460–1472.

Abbeduto, L., Davies, B., Solesby, S., & Furman, L. (1991). Identifying the referents of spoken messages: Use of context and clarification requests by children with and without mental retardation. *American Journal on Mental Retardation, 95,* 551–562.

Abbeduto, L., Furman, L., & Davies, B. (1989). Relation between receptive language and mental age in persons with mental retardation. *American Journal on Mental Retardation, 93,* 535–543.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1986). Mechanical, behavioural, and intentional understanding of picture stories in autistic children. *British Journal of Developmental Psychology, 4,* 113–125.

Baron-Cohen, S., Tager-Flusberg, H., & Cohen, D. (Eds.). (1992). *Understanding other minds: Perspectives from autism.* New York: Oxford University Press.

Bates, E. (1992). Language development. *Current Opinion in Neurobiology, 2,* 180–185.

Bates, E., & Snyder, L. C. (1987). The cognitive hypothesis in language development. In I. C. Uzgiris & J. McV. Hunt (Eds.), *Infant performance and experience: New findings with the ordinal scales* (pp. 168–204). Urbana: University of Illinois Press.

Bates, E., Thal, D., & Janowsky, J. S. (1992). Early language development and its neural correlates. In S. J. Segalowitz & I. Rapin (Eds.), *Handbook of neuropsychology: Vol. 7. Child neuropsychology* (pp. 69–110). Amsterdam: Elsevier Science Publishers.

Bellugi, U., Bihrle, A., Jernigan, T., Trauner, D., & Doherty, S. (1990). Neuropsychological, neurological, and neuroanatomical profile of Williams syndrome. *American Journal Of Medical Genetics*, 6 (Suppl.), 115–125.

Bellugi, U., Bihrle, A., Neville, H., Jernigan, T., & Doherty, S. (1993). Language, cognition, and brain organization in a neurodevelopmental disorder. In M. Gunnar & C. Nelson (Eds.), *Developmental behavioral neuroscience*. Hillsdale, NJ: Erlbaum.

Bellugi, U., Marks, S., Bihrle, A., & Sabo, H. (1988). Dissociation between language and cognitive functions in Williams syndrome. In D. Bishop & K. Mogford (Eds.), *Language development in exceptional circumstances* (pp. 177–189). London: Churchill Livingstone.

Bellugi, U., Wang, P. P., & Jernigan, T. L. (1994). Williams Syndrome: An unusual neuropsychological profile. In S. H. Broman & J. Grafman (Eds.), *Atypical cognitive deficits in developmental disorders: Implications for brain function* (pp. 23–56). Hillsdale, NJ: Erlbaum.

Beveridge, M., & Conti-Ramsden, G. (1987). Social cognition and problem-solving in persons with mental retardation. *Australia and New Zealand Journal of Developmental Disabilities*, 13, 99–106.

Bilovsky, D., & Share, J. (1965). The ITPA and Down's Syndrome: An exploratory study. *American Journal of Mental Deficiency*, 70, 78–82.

Bilsky, L. H., Walker, N., & Sakales, S. R. (1983). Comprehension and recall of sentences by mentally retarded and nonretarded individuals. *American Journal of Mental Deficiency*, 87, 558–565.

Bishop, D. V. M. (1982). *Test for Reception of Grammar*. Unpublished test. Manchester, Eng.: Department of Psychology.

Bishop, D. V. M., & Adams, C. (1990). A prospective study of the relationship between specific language impairment, phonological disorders, and reading retardation. *Journal of Child Psychology and Psychiatry*, 31, 1027–1050.

Boehm, A. (1971). *The Boehm Test of Basic Concepts*. New York: Psychological Corporation.

Bolognini, M., Guidollet, B., Plancherel, B., & Bettschart, W. (1988). Mentally retarded adolescents: Evaluation of communication strategies in different settings. *International Journal of Rehabilitation and Research*, 11, 369–378.

Borghgraef, M., Fryns, J. P., & Van der Berghe, H. (1988). Psychological findings in three children with ring 15 chromosome. *Journal of Mental Deficiency Research*, 32, 337–347.

Bradley, E. A., & Udwin, O. (1989). Williams syndrome in adulthood: A case study focusing on psychological and psychiatric aspects. *Journal of Mental Deficiency Research*, 33, 175–184.

Brady, S. (1991). The role of working memory in reading disability. In S. Brady & D. Shankweiler (Eds.), *Phonological processes in literacy: A tribute to Isabelle Y. Liberman* (pp. 129–151). Hillsdale, NJ: Erlbaum.

Bridges, A., & Smith, J. (1984). Syntactic comprehension in Down's Syndrome children. *British Journal of Psychology*, 75, 187–196.

Broadley, I., MacDonald, J., & Buckley, S. (1995). Working memory in children with Down's syndrome. *Down's Syndrome Research and Practice*, 3, 3–8.

Buckley, S. (1993). Developing the speech and language skills of teenagers with Down's syndrome. In S. Buckley (Ed.), *Down's syndrome research and practice* (pp. 63–71). Portsmouth, Eng.: University of Portsmouth.

Burgemeister, B., Blum, L., & Lorge, I. (1972). *The Columbia Mental Maturity Scale*. New York: Harcourt Brace Jovanovich.

Cantwell, D. P., & Baker, L. (1987). Psychiatric symptomatology in language-impaired children: A comparison. *Journal of Child Neurology*, 2, 128–133.

Cardoso-Martins, C., Mervis, C. B., & Mervis, C. A. (1985). Early vocabulary acquisition by children with Down syndrome. *American Journal of Mental Deficiency*, 90, 177–184.

Chapman, R. (1993). *Longitudinal change in language production of children and adolescents with Down syndrome*. Presented at the Sixth International Conference for the Study of Child Language, Trieste, Italy.

Chapman, R. S., Ranning-Bird, E. K., & Schwartz, S. E. (1990). Fast mapping of words in event contexts by children with Down syndrome. *Journal of Speech and Hearing Disorders*, 55, 761–770.

Cholmain, C. N. (1994). Working on phonology with young children with Down syndrome – A pilot study. *Journal of Clinical Speech and Language Studies*, 1, 14–35.

Clahsen, H. (1989). The grammatical characterization of developmental dysphasia. *Linguistics*, 27, 897–920.

Clahsen, H., Rothweiler, M., Woest, A., & Marcus, G. F. (1992). Regular and irregular inflection in the acquisition of German noun plurals. *Cognition*, 45, 225–255.

Coggins, T. E., & Fredrickson, R. (1988). Brief report: The communicative role of a frequently repeated utterance in the conversations of an autistic boy. *Journal of Autism and Developmental Disorders*, 18, 687–694.

Cole, K. N., Dale, P. S., & Mills, P. E. (1992). Stability of the intelligence quotient – language quotient relation: Is discrepancy modeling based on a myth? *American Journal on Mental Retardation*, 97, 131–143.

Comblain, A. (in press). Working memory in Down syndrome: Training the rehearsal strategy. *Down Syndrome Research and Practice*.

Crisco, J. J., Dobbs, J. M., & Mulhern, R. K. (1988). Cognitive processing of children with Williams syndrome. *Developmental Medicine and Child Neurology*, 30, 650–656.

Cromer, R. F. (1974). Receptive language in the mentally retarded. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives: Acquisition, retardation, and intervention*. Baltimore: University Park Press.

———. (1976). The cognitive hypothesis. In D. M. Morehead & A. E. Morehead (Eds.), *Normal and deficient child language*. Baltimore: University Park Press.

———. (1987). Word knowledge acquisition in retarded children: A longitudinal study of acquisition of a complex linguistic structure. *Journal of Speech and Hearing Disorders*, 52, 324–334.

———. (1991). *Language and thought in normal and handicapped children*. Oxford: Basil Blackwell.

———. (1994). A case study of dissociations between language and cognition. In H. Tager-Flusberg (Ed.), *Constraints on language acquisition: Studies of atypical children* (pp. 141–153). Hillsdale, NJ: Erlbaum.

Crosley, P., & Dowling, S. (1989). The relationship between cluster and liquid simplification and sentence length, age, and IQ in Down's syndrome children. *Journal of Communication Disorders*, 22, 151–168.

Curtiss, S. (1988a). Abnormal language acquisition and the modularity of language. In F. E. Newmeyer (Ed.), *Linguistics: The Cambridge survey: Vol. 1. Linguistic theory: Extensions and implication* (pp. 96–116). Cambridge: Cambridge University Press.

———. (1988b). The special talent of grammar acquisition. In L. Obler & F. D. (Eds.), *The exceptional brain* (pp. 364–386). New York: Guilford Press.

Damasio, A. R., & Damasio, H. (1992). Brain and language. *Scientific American, 117,* 89–95.

Dewart, M. H. (1979). Language comprehension processes of mentally retarded children. *American Journal of Mental Deficiency, 84,* 177–183.

Dodd, B. (1976). A comparison of phonological systems of mental age matched normal, severely subnormal, and Down's syndrome children. *British Journal of Disorders of Communication, 11,* 27–42.

Doherty, B. J. (1993). *Relationships between phonological processes and reading ability in young adults with Down syndrome.* Unpublished master's thesis, Bryn Mawr College.

Duchan, J. F., & Erickson, J. G. (1976). Normal and retarded children's understanding of semantic relations in different verbal contexts. *Journal of Speech and Hearing Research, 19,* 767–776.

Dunn, L., & Dunn, L. (1981). *Peabody-Picture Vocabulary Test – Revised (PPVT-R).* Circle Pines, MN: American Guidance Service.

Dykens, E. M., Hodapp, R. M., & Evans, D. W. (1994). Profiles and development of adaptive behavior in children with Down syndrome. *American Journal on Mental Retardation, 98,* 580–587.

Dykens, E. M., Hodapp, R. M., & Leckman J. F. (1994). *Behavior and development in fragile X syndrome.* Thousand Oaks, CA: Sage Publications.

Ellis, N. (1970). Memory processes in retardates and normals. In *International Review of Research in Mental Retardation* (pp. 1–32). New York: Academic Press.

Ezell, H. K., & Goldstein, H. (1991). Comparison of idiom comprehension of normal children and children with mental retardation. *Journal of Speech and Hearing Research, 34,* 812–819.

(1992). Teaching idiom comprehension to children with mental retardation. *Journal of Applied Behavior Analysis, 25,* 181–191.

Fazio, B. B., Johnston, J. R., & Brandl, L. (1993). Relation between mental age and vocabulary development among children with mild mental retardation. *American Journal of Mental Retardation, 97,* 541–546.

Ferrier, L. J., Bashir, A. S., Meryash, D. L., Johnston, J., & Wolff, P. (1991). Conversational skills of individuals with fragile-X syndrome: A comparison with autism and Down syndrome. *Developmental Medicine and Child Neurology, 33,* 766–788.

Fletcher, K. L., & Bray, N. W. (1995). External and verbal strategies in children with and without mild mental retardation. *American Journal on Mental Retardation, 99,* 363–375.

Fletcher, P. (1990). Speech and language defects. *Nature, 346,* 226.

Fowler, A. (1984) *Language acquisition in Down's syndrome children: Production and comprehension.* Unpublished doctoral dissertation, University of Pennsylvania.

(1988). Determinants of rate of language growth in children with Down syndrome. In L. Nadel (Eds.), *The psychobiology of Down syndrome.* Cambridge, MA: MIT Press.

(1990). Language abilities in children with Down syndrome: Evidence for a specific syntactic delay. In D. Cicchetti & M. Beeghly (Eds.), *Children with Down syndrome: A developmental perspective* (pp. 302–328). New York: Cambridge University Press.

(1995). Linguistic variability in persons with Down syndrome: Research and im-

plications. In L. Nadel & D. Rosenthal (Eds.), *Down syndrome: Living and learning in the community* (pp. 121–136). New York: Wiley-Liss.

Fowler, A., Gelman, R., & Gleitman, R. (1994). The course of language learning in children with Down syndrome: Longitudinal and language level comparisons with young normally developing children. In H. Tager-Flusberg (Eds.), *Constraints on language acquisition: Studies of atypical populations* (pp. 91–140). Hillsdale, NJ: Erlbaum.

Frith, U. (1989). *Autism: Explaining the enigma.* Oxford: Blackwell.

Gathercole, S., & Adams, A. M. (1993). Phonological working memory in very young children. *Developmental Psychology, 29,* 770–778.

Gathercole, S., & Baddeley, A. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. *Journal of Memory and Language, 28,* 200–213.

(1990). Phonological memory deficits in language-disordered children: Is there a causal connection? *Journal of Memory and Language, 81,* 439–454.

Gleitman, L. R., & Wanner, E. (1982). Language acquisition: The state of the state of the art. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 3–48). New York: Cambridge University Press.

Gopnik, M. (1990). Dysphasia in an extended family. *Nature, 344,* 715.

Gosch, A., Stading, G., & Pankau, R. (1994). Linguistic abilities in children with Williams-Beuren syndrome. *American Journal of Medical Genetics, 52,* 291–296.

Graham, N. C. (1974). Response strategies in the partial comprehension of sentences. *Language and Speech, 17,* 205–221.

Hagerman, R. J., & Sobesky, W. E. (1989). Psychopathology in fragile X syndrome. *American Journal of Orthopsychiatry, 59,* 142–152.

Happe, F. G. E. (1995). The role of age and verbal ability in the theory of mind performance of subjects with autism. *Child Development, 66,* 843–855.

Hemphill, L., Picardi, N., & Tager-Flusberg, H. (1991). Narrative as an index of communicative competence in mildly mentally retarded children. *Applied Psycholinguistics, 12,* 263–279.

Hemphill, L., & Siperstein, G. N. (1990). Conversational competence and peer response to mildly retarded children. *Journal of Educational Psychology, 82,* 128–134.

Hodapp, R. M., Leckman, J. F., Dykens, E. M., Sparrow, S., Zelinsky, D., & Ort, S. (1992). K-ABC profiles in children with fragile X syndrome, Down syndrome, and nonspecific mental retardation. *American Journal on Mental Retardation, 97,* 39–46.

Hulme, C., & MacKenzie, S. (1992). *Working memory and severe learning difficulties.* Hillside, NJ: Erlbaum.

Hulme, C., Maugham, S., & Brown, G. (1991). Memory for familiar and unfamiliar words: Evidence for a long-term memory contribution to short-term memory span. *Journal of Memory and Language, 30,* 685–701.

Johnson, S. C., & Carey, S. (1995, March). *When the facts are not enough: Conceptual change in people with Williams syndrome.* Poster presented at Society for Research in Child Development, Indianapolis.

Jordan, T. E. (1976). Language. In *The mentally retarded* (pp. 283–342). Columbus, OH: Charles Merrill Pub. Co.

Kamhi, A. G., & Johnston, J. R. (1982). Towards an understanding of retarded children's linguistic deficiencies. *Journal of Speech and Hearing Research, 25,* 435–445.

Katz, R. B. (1986). Phonological deficiencies in children with reading disability. *Cognition, 22*, 250–257.

Kent, R. D. (1993). Speech intelligibility and communicative competence in children. In A. P. Kaiser & D. B. Gray (Eds.), *Enhancing children's communication.* Baltimore, MD: Brookes Publishing.

Kernan, K. T. (1990). Comprehension of syntactically indicated sequence by Down's syndrome and other mentally retarded adults. *Journal of Mental Deficiency Research, 34*, 169–178.

Kernan, K. T., & Sabsay, S. (1987). Referential first mention in narratives by mildly mentally retarded adults. *Research in Developmental Disabilities, 8*, 361–369.

Kleppe, S. A., Katayama, K. M., Shipley, K. G., & Foushee, D. R. (1990). The speech and language characteristics of children with Prader-Willi syndrome. *Journal of Speech and Hearing Disorders, 55*, 300–309.

Klink, M., Gerstman, L., Raphael, L., Schlanger, B. B., & Newsome, L. (1986). Phonological process usage by young EMR children and nonretarded preschool children. *American Journal of Mental Deficiency, 91*, 190–195.

Kumin, L. (1994). Intelligibility of speech in children with Down syndrome in natural settings: Parents' perspective. *Perceptual and Motor Skills, 78*, 307–313.

Lackner, J. (1986). A developmental study of language behavior in retarded children. In D. M. Morehead & A. E. Morehead (Eds.), *Normal and deficient child language.* Baltimore: University Park Press.

Lebrun, I., & Van Borsel, J. (1991). Final sound repetitions. *Journal of Fluency Disorders, 15*, 107–113.

Ledesma, L. K., Ortiz, M. H., Gonzaga, F. C., Lee, L. V., et. al. (1991). Speech delay in Filipino children: A clinical profile. *Philippine Journal of Psychology, 24*, 20–25.

Lee, A., Hobson, R. P., & Chiat, S. (1994). I, you, me, and autism: An experimental study. *Journal of Autism and Developmental Disorders, 24*, 155–176.

Lenneberg, E. H. (1967). *Biological foundations of language.* New York: Wiley.

Leonard, L. B., McGregor, K. K., & Allen, G. D. (1992). Grammatical morphology and speech perception in children with specific language impairment. *Journal of Speech and Hearing Research, 35*, 1076–1085.

Leslie, A. M., & Frith, U. (1988). Autistic children's understanding of seeing, knowing, and believing. *British Journal of Developmental Psychology, 6*, 315–324.

Linebarger, M. C., Schwartz, M. F., & Saffran, E. M. (1983). Sensitivity to grammatical structure in so-called agrammatic aphasics. *Cognition, 13*, 361–392.

Locke, J. L. (1994). Gradual emergence of developmental language disorders. *Journal of Speech and Hearing Research, 37*, 608–616.

Loveland, K. A., Tunali, B., McEvoy, R., & Kelly, M. L. (1989). Referential communication and response adequacy in Autism and Down's syndrome. *Applied Psycholinguistics, 10*, 301–313.

McEvoy, J. (1992). Fragile X syndrome: A brief overview. *Educational Psychology in Practice, 8*, 146–149.

MacKenzie, S., & Hulme, C. (1987). Memory span development in Down's syndrome, severely subnormal and normal subjects. *Cognitive Neuropsychology, 4*, 303–319.

Maratsos, M., & Matheny, L. (1994). Language specificity and elasticity: Brain and clinical syndrome studies. *Annual Review of Psychology, 45*, 487–516.

Marcell, M. M. (1992). Hearing abilities of Down syndrome and other mentally handicapped adolescents. *Research in Developmental Disabilities, 13*, 533–551.

Marcell, M., & Armstrong, V. (1982). Auditory and visual sequential memory of

Down syndrome and nonretarded children. *American Journal on Mental Deficiency, 87*, 86–95.

Marcell, M. M., Croen, P. S., Mansker, J. K., & Sizemore, T. D. (1994, April). *Language Comprehension by Down syndrome and other mentally handicapped youth.* Poster presented at the International Down Syndrome Conference, Charleston, SC.

Marcell, M. M., Croen, P. S., & Sewell, D. H. (1990). *Language comprehension in Down syndrome and other trainable mentally handicapped individuals.* Paper presented at the Conference on Human Development, Richmond, VA.

Marcell, M. M., & Weeks, S. L. (1988). Short-term memory difficulties and Down's syndrome. *Journal of Mental Deficiency Research, 32*, 153–162.

Merrill, E. C., & Bilsky, L. H. (1990). Individual differences in the representation of sentences in memory. *American Journal on Mental Retardation, 95*, 68–76.

Merrill, E. C., & Jackson, T. S. (1992). Degree of associative relatedness and sentence processing by adolescents with and without mental retardation. *American Journal on Mental Retardation, 97*, 173–185.

Mervis, C. B. (1987). Child-basic object categories and early lexical development. In U. Neisser (Ed.), *Concepts and conceptual development: Ecological and intellectual factors in categorization.* Cambridge: Cambridge University Press.

Mervis, C. B., & Bertrand, J. (1993). Acquisition of early object labels: The roles of operating principles and input. In A. P. Kaiser & D. B. Gray (Eds.), *Enhancing children's communication.* Baltimore: Brookes Publishing.

Meyerson, M. D., & Frank, R. A. (1987). Language, speech and hearing in Williams syndrome: Intervention approaches and research needs. *Developmental Medicine and Child Neurology, 29*, 258–270.

Miller, J. A., Leddy, M., Miolo, G., & Sedey, A. (1995). The development of early language skills in children with Down syndrome. In L. Nadel & D. Rosenthal (Eds.), *Down syndrome: Living and learning in the community* (pp. 115–120). New York: Wiley-Liss.

Miller, J. F. (1987). Language and communication characteristics of children with Down syndrome. In S. Pueschel, C. Tinghey, J. Rynders, A. Crocker, & C. Crutcher (Eds.), *New perspectives on Down syndrome* (pp. 233–262). Baltimore: Brookes Publishing.

(1988). The developmental asynchrony of language development in children with Down syndrome. In L. Nadel (Ed.), *The psychobiology of Down syndrome.* Cambridge, MA: MIT Press.

Miller, J. F., & Chapman, R. S. (1984). Disorders of communication: Investigating the development of language of mentally retarded children. *American Journal of Mental Deficiency, 88*, 536–545.

Miller, J. F., Chapman, R. S., & Bedrosian, J. L. (1978). The relationship between etiology, cognitive development and language and communicative performance. *The New Zealand Speech Therapists' Journal, 33*, 2–17.

Mody, M., Studdert-Kennedy, M., & Brady, S. (1997). Speech perception deficits in poor readers: Auditory processing or phonological coding? *Journal of Experimental Child Psychology.*

Naigles, L., Fowler, A., & Helm, A. (1995). Syntactic bootstrapping from start to finish with special reference to Down syndrome. In M. Tomasello & W. Merriman (Eds.), *Beyond names for things: Young children's acquisition of verbs.* Hillsdale, NJ: Erlbaum, pp. 299–330.

Natsopoulos, D., & Xeromeritou, A. (1990). Language behavior by mildly handi-

capped and nonretarded children on complement clauses. *Research in Developmental Disabilities, 11*, 199–216.

Newport, E. (1990). Maturational constraints on language learning. *Cognitive Science, 14*, 11–28.

Nuccio, J. B., & Abbeduto, L. (1993). Dynamic contextual variables and the directives of persons with mental retardation. *American Journal of Mental Retardation, 97*, 547–558.

O'Connor, N., & Hermelin, B. (1988). Low intelligence and special abilities. *Journal of Child Psychology and Psychiatry, 29*, 391–396.

Oetting, J. B., & Rice, M. L. (1991). Influence of the social context on pragmatic skills of adults with mental retardation. *American Journal on Mental Retardation, 95*, 435–443.

Paul, R., Cohen, D. J., Breg, W. R., Watson, M., & Herman, S. (1984). Fragile X Syndrome: Its relations to speech and language disorders. *Journal of Speech and Hearing Disorders, 49*, 328–332.

Paul, R., Dykens, E., Leckman, J. F., Watson, M., Breg, R. W., & Cohen, D. J. (1987). A comparison of language characteristics of mentally retarded adults with fragile X syndrome and those with nonspecific mental retardation and autism. *Journal of Autism and Developmental Disorders, 17*, 457–468.

Pueschel, S. (1988). Visual and auditory processing in children with Down syndrome. In L. Nadel (Eds.), *The Psychobiology of Down Syndrome* (pp. 199–216). Cambridge, MA: MIT Press.

Racette, K. (1993) *Phonological bases of memory in normal preschoolers and young adults with Down syndrome.* Unpublished master's thesis, Bryn Mawr College.

Rao, T. S., & Srinivas, N. C. (1988). Speech and language deficits and mental retardation: A report on the analysis of 300 mentally retarded persons. *Indian Journal of Disability and Rehabilitation, 3*, 31–43.

Rapin, I., Allen, D. A., & Dunn, M. A. (1992). Developmental language disorders. In S. J. Segalowitz & I. Rapin (Eds.), *Handbook of Neuropsychology* (pp. 111–137). Amsterdam: Elsevier Science Publishing.

Reilly, J., Klima, E. S., & Bellugi, U. (1991). Once more with feeling: Affect and language in atypical populations. *Development and Psychopathology, 2*, 367–391.

Roberts, J. M. A. (1989). Echolalia and comprehension in autistic children. *Journal of Autism and Developmental Disorders, 19*, 271–281.

Rondal, J. (1994). Exceptional cases of language development in mental retardation: The relative autonomy of language as a cognitive system. In H. Tager-Flusberg (Ed.), *Constraints on language development: Studies of atypical children.* Hillsdale, NJ: Erlbaum.

(1995). *Exceptional language development in Down syndrome. A case study and its implications for cognition-language and other language-modularity issues.* New York: Cambridge University Press.

Rosenberg, S., & Abbeduto, L. (1987). Indicators of linguistic competence in the peer group conversational behavior of mildly retarded adults. *Applied Psycholinguistics, 8*, 19–32.

(1993). *Language and communication in mental retardation.* Hillsdale, NJ: Erlbaum.

Rueda, R., & Chan, K. S. (1980). Referential communication skill levels of moderately mentally retarded adolescents. *American Journal of Mental Deficiency, 85*, 45–52.

Rutter, M. (1978). Diagnosis and definitions of childhood autism. *Journal of Autism and Developmental Disorders, 8*, 139–161.

Scarborough, H. S., Rescorla, L., Tager-Flusberg, H., Fowler, A. E., & Sudhalter, V.

(1991). The relation of utterance length to grammatical complexity in normal and language-disordered groups. *Applied Psycholinguistics, 12*, 23–45.

Seagoe, M. V. (1964). Verbal development in a mongoloid. *Exceptional Children, 31*, 269–273.

Shriberg, L. D., & Kwiatkowski, J. (1988). A follow-up study of children with phonological disorders of unknown origin. *Journal of Speech and Hearing Disorders, 53*, 144–155.

Silva, P. A., McGee, R., & Williams, S. M. (1983). Developmental language delay from three to seven years and its significance for low intelligence and reading difficulties at age seven. *Developmental Medicine and Child Neurology, 25*, 783–793.

Smith, B. L., & Stoel-Gammon, C. (1983). A longitudinal study of the development of stop consonant production in normal and Down's syndrome children. *Journal of Speech and Hearing Disorders, 48*, 114–118.

Spinelli, M., de Oliveria Rocha, A. C., Giacheti, C. M., & Richieri-Costa, A. (1995). Word-finding difficulties, verbal paraphasias, and verbal dyspraxia in ten individuals with fragile X syndrome. *American Journal of Medical Genetics, 60*, 39–43.

Stoel-Gammon, C. (1980). Phonological analysis of four Down's syndrome children. *Applied Psycholinguistics, 1*, 31–48.

Stough, C., Nettlebeck, T., & Ireland, G. (1988). Objectively identifying the cocktail party syndrome among children with spina bifida. *The Exceptional Child, 35*, 23–30.

Studdert-Kennedy, M., & Mody, M. (1995). Auditory temporal perception deficits in the reading-impaired: A critical review of the evidence. *Psychonomic Bulletin and Review, 2*, 508.

Sudhalter, V., Cohen, I. L., Silverman, W., & Wolf-Schein, E. G. (1990). Conversational analyses of males with fragile X, Down syndrome and autism: A comparison of the emergence of deviant language. *American Journal of Mental Retardation, 94*, 431–441.

Sudhalter, V., Maranion, M., & Brooks, P. (1992). Expressive semantic deficit in the productive language of males with fragile X syndrome. *American Journal of Medical Genetics, 43*, 65–71.

Sudhalter, V., Scarborough, H., & Cohen, I. (1991). Syntactic delay and pragmatic deviance in the language of fragile X males. *American Journal of Medical Genetics, 38*, 493–497.

Tager-Flusberg, H. (1981). Sentence comprehension in autistic children. *Applied Psycholinguistics, 2*, 5–24.

(1985a). Basic level and superordinate level categorizaton by autistic, mentally retarded, and normal children. *Journal of Experimental Child Psychology, 40*, 450–469.

(1985b). The conceptual basis for referential word meaning in children with autism. *Child Development, 56*, 1167–1178.

(1989). A psycholinguistic perspective on the autistic child. In G. Dawson (Ed.), *Autism: Nature, diagnosis, and treatment* (pp. 92–115). New York: Guilford Press.

(1992). Autistic children's talk about psychological states: Deficits in the early acquisition of a theory of mind. *Child Development, 63*, 161–172.

(1993). What language reveals about the understanding of minds in children with autism. In S. Baron-Cohen, H. Tager-Flusberg, & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from autism* (pp. 138–157). Oxford: Oxford University Press.

(1994). Dissociations in form and function in the acquisition of language by autistic children. In H. Tager-Flusberg (Ed.), *Constraints on language acquisition: Studies of atypical children* (pp. 175–194). Hillsdale, NJ: Erlbaum.

Tager-Flusberg, H., Calkins, S., Nolin, T., Baumberger, T., Anderson, M., & Chadwick-Dias, A., (1990). A longitudinal study of language acquisition in autistic and Down syndrome children. *Journal of Autism and Developmental Disorders, 20,* 1–21.

Tager-Flusberg, H., & Sullivan, K. (1994). Predicting and explaining autistic behavior: A comparison of autistic, mentally retarded, and normal children. *Journal of Child Psychology and Psychiatry, 35,* 1059–1075.

Tew, B. (1979). The "cocktail party syndrome" in children with hydrocephalus and spina bifida. *British Journal of Disorders of Communication, 14,* 89–101.

Thurber, C., & Tager-Flusberg, H. (1993). Pauses in the narratives produced by autistic, mentally retarded, and normal children as an index of cognitive demand. *Journal of Autism and Developmental Disorders, 23,* 309–322.

Tilstra, D. J., Grove, M., Spencer, A. C., Norwood, T. H., & Pagon, R. A. (1993). Brief clinical report: Mosaic Isochrome 8p. *American Journal on Medical Genetics, 46,* 517–519.

Udwin, O. (1990). A survey of adults with Williams syndrome and idiopathic infantile hypercalcaemia. *Developmental Medicine and Child Neurology, 32,* 129–141.

Udwin, I., Yule, W., & Martin, N. (1987). Cognitive abilities and behavioral characteristics of children with idiopathic infantile hypercalcaemia. *Journal of Child Psychology and Psychiatry, 28,* 297–309.

Van Borsel, J. (1988). An analysis of the speech of five Down's syndrome adolescents. *Journal of Communication Disorders, 21,* 409–421.

Van Lancker, D., Cornelius, C., & Needleman, R. (1991). Comprehension of verbal terms in normal, autistic, and schizophrenic children. *Developmental Neuropsychology, 7,* 1–18.

Vargha-Khadem, F., & Passingham, R. (1990). Speech and language defects. *Nature, 346,* 226.

Varnhagen, C. K., Das, J. P., & Varnhagen, S. (1987). Auditory and visual memory span: Cognitive processing by TMR individuals with Down syndrome and other etiologies. *American Journal of Mental Deficiency, 91*(4), 398–405.

Vig, S., Kaminer, R. K., & Jedrysek, E. (1987). A later look at borderline and mildly retarded preschoolers. *Developmental and Behavioral Pediatrics, 8,* 12–17.

Vygotsky, L. S. (1962). *Thought and language.* Cambridge, MA: MIT Press. (First published 1934).

Walzer, S. (1985). X chromosome abnormalities and cognitive development: Implications for understanding normal human development. *Journal of Child Psychology and Psychiatry, 26,* 177–184.

Wang, P. P., & Bellugi, U. (1994). Evidence from two genetic syndromes for a dissociation between verbal and visual-spatial short-term memory. *Journal of Clinical and Experimental Neuropsychology, 16,* 317–322.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13,* 103–128.

Wolf-Schein, E. G., Sudhalter, V., Cohen, I. L., Fisch, G. L. S., Hanson, D., Pfadt, A., Hagerman, R., Jenkins, E. C., & Brown, W. T. (1987). Speech-language and the fragile X syndrome: Initial findings. *ASHA, 29,* 35–38.

Yamada, J. (1990). *Laura: A case for the modularity of language.* Cambridge, MA: MIT Press.

Yoder, P. J., & Davies, B. (1992). Do children with developmental delays use more frequent and diverse language in verbal routines? *American Journal on Mental Retardation, 97,* 197–208.

Yoder, P. J., Davies, B., & Bishop, K. (1994). Adult interaction style effects on the language sampling and transcription process with children who have developmental disabilities. *American Journal on Mental Retardation, 99,* 270–282.