

Down Syndrome

Living and Learning in the Community

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Linguistic Variability in Persons with Down Syndrome: Research and Implications

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In studies of persons with Down syndrome, as in classrooms and homes, two areas of cognitive function stand out as being of particular concern: the ability to hold verbal information in mind (verbal memory), and the acquisition and use of syntactic and morphological aspects of language (linguistic structure). These often constitute relative weaknesses in contrast to relative strengths in social communication, receptive vocabulary, and visual-spatial function (e.g., Fowler, 1990; Miller, 1987, 1988). At the same time, however, there is tremendous variability within the syndrome with regard to language function. For example, although normally developing children produce their first words between 6 and 14 months, children with Down syndrome begin producing words anytime between 9 months and 7 years; normally developing children put words together into simple sentences somewhere between 14 and 32 months, whereas children with Down syndrome make their first two-word combinations somewhere between 18 months and 8 or even 11 years. These onset measures vary individually from within the normal range to delays that are nothing short of frustrating (Stray-Gundersen, 1986). This extreme variability is evident as well in ultimate language attainments: although language is often limited (e.g., Wisniewski et al., 1988), there are many highly fluent adults to provide exception to that generalization (e.g., Rondal, 1994).

Why do so many persons with Down syndrome experience disproportionate difficulty in language and memory, and why are ultimate levels of language attainment so much greater in some individuals than in others? Is it the case that having Down syndrome puts a child "at risk" for language difficulties or do linguistic successes in even some individuals argue against that?

Two caveats are in order. First, it must be acknowledged that we have only just begun to tap the potential of persons with Down syndrome. For too long, expectations imposed at birth have limited this group, depriving them of educational opportunity and often of homes. With some of these barriers removed, there are now scores of

young adults with Down syndrome who have violated all prior expectations, and the children growing up today may exceed even these attainments. A second caveat concerns the scope of what is meant by "language." Here the focus is on the structural rule-governed aspects of language—the formal system by which sounds are combined into words (phonology), and words into grammatically well-formed sentences (morpho-syntax). Whether assessed in comprehension or production, it is these structural aspects of language that appear to be disproportionately affected in Down syndrome, relative to other aspects of cognitive function. With these caveats firmly in place, three questions may be asked: 1) what is the nature of the difficulty; 2) what are the underlying sources of linguistic variation; and 3) how can we respond to the information we have?

WHAT IS THE NATURE OF THE DIFFICULTY?

Evidence for a specific difficulty with language derives from three different kinds of comparisons: verbal versus nonverbal processing; linguistic versus nonlinguistic communication; and syntax and grammar versus lexical knowledge.

Comparisons of Verbal and Nonverbal Processing

It has consistently been noted that linguistic processing abilities in persons with Down syndrome lag behind nonlinguistic processing abilities (e.g., Bilovsky and Share, 1965; Marcell and Weeks, 1988; Varnhagen et al., 1987). In a recent study it was found that even in young adults recruited on the basis of "good" verbal skills, sequential (largely verbal) abilities lagged significantly ($p < .05$) behind nonsequential (largely visual-spatial) abilities in 18 of 33 cases (Doherty, 1993; Fowler et al., 1993); there was at least a trend in that direction in 79% of all subjects. In contrast, only two (6%) of these adults showed a significant verbal advantage ($p < .05$). In the same study, subject scores on a visual-spatial task qualified as significant *strengths* relative to the composite *weaknesses* in 18 of 33 cases; performance overall on visual spatial processing was significantly better than performance on each of three different measures of sequential processing. Lest these results be construed as indicating a general difficulty with sequential processing, it should be added that the subjects achieved significantly higher age-equivalent scores when asked to replicate a series of hand shapes (which can be encoded visually, motorically, or linguistically) than when asked to retain strings of digits or common names (Doherty, 1993; for similar findings, see also Pueschel, 1988). Verbal memory was assessed without necessarily requiring a verbal output; in some cases, subjects could indicate an appropriate response by sequential pointing.

That verbal processing is a specific area of weakness is also evident in a direct comparison of the same young adults with Down syndrome with normally intelligent adults and much younger children matched on verbal memory. In this case, verbal span was based on the number of digits that could be recalled in the correct sequence, and visual-spatial span on the number of tapped blocks that could be reproduced sequentially without error. (To discourage the use of verbal encoding strategies, the blocks were identical in color and size and randomly scattered on a board.) It is

generally the case that subjects perform better on the verbal measure, and this was the overall result in this study as well [$F(1,47) = 15.58; p < .001$]. However, there was a significant interaction between task and group. For both groups with Down syndrome, the word span exceeded the block span (see Fig. 1); for the case of the young adults with Down syndrome, there was a slight trend in the opposite direction (Racette, 1993). Interestingly, this pattern of verbal weakness seems to be more a function of the fact that these young adults have Down syndrome than it is a reflection of their overall cognitive difficulties. Quite different profiles are evident in other well-studied forms of congenital retardation. For example, in persons with fragile X syndrome, processing deficits extend to all kinds of sequential processing, linguistic or not, suggesting that the underlying problem may be more attentional than linguistic (Dykens et al., 1993). And in persons with Williams syndrome, it is the verbal processing abilities that significantly and consistently exceed performance on visual-spatial abilities (e.g., Bellugi et al., 1988).

Dissociations within the Language System

Within the broader language system, it often seems that a lot more is being communicated than objective measures of morpho-syntactic structure would suggest. Although it is not easy to assess communicative (pragmatic) function quantitatively, several studies suggest that clinical intuition may be accurate. For example, there is now evidence that children with Down syndrome at the one- and two-word stage of spoken language development display conversational skills not yet evident in normally developing children at that same language level; they engage in complex imaginative play sequences and have mastered such conversational rules as turn-taking, making appropriate responses to questions, and making repairs when they are not understood (e.g., Beeghly et al., 1990; Coggins and Stoel-Gammon, 1982; Greenwald and Leonard, 1979; Mahoney et al., 1981; Peskett and Wootton, 1985). Children with Down syndrome also appear to have better social understanding than would be expected on the basis of developmental level (e.g., Baren-Cohen et al., 1992). In adults too, studies of communicative function (including gestures and turn-taking) suggest that there is much communication going on even in those persons who are essentially nonverbal (Price-Williams and Sabsay, 1979).

The acquisition of morpho-syntax also appears to be generally less well-developed than conceptual aspects of lexical knowledge, at least as assessed via receptive vocabulary measures (Fowler, 1990; Miller, 1987, 1988). For instance, in Fowler et al. (1993), adolescents had receptive vocabulary levels equivalent to a six-year-old, but functioned more like three-year-olds in terms of the complexity of the sentence structures they could produce and understand. Performance on standardized receptive vocabulary measures exceeded performance on standardized measures of syntactic comprehension in 31 of 31 cases. (See Chapman et al., 1993, for similar results using a large sample of children 5–20 years of age.) What is of particular interest in all these studies is the fact that although actual levels of language structure vary tremendously, the profile remains relatively constant even in those functioning at the highest levels.

WHAT UNDERLIES DIFFICULTIES IN VERBAL MEMORY AND MORPHO-SYNTAX?

Although there is strong evidence that verbal memory and morpho-syntactic structure are areas of relative weakness in Down syndrome, it is less clear why this should be so. Why too is there such wide linguistic variability? Several possibilities present themselves; it should be noted that multiple factors may be operating to the same effect.

Environmental Factors

It is demonstrably the case that environmental factors have an important effect on overall levels of cognitive function. Persons with Down syndrome benefit from loving homes, early intervention, appropriate educational services and medical care, and positive expectations communicated by family, school, and the broader community (e.g., Hodapp and Zigler, 1990). On the other hand, structural linguistic skills may be markedly delayed even when other environmentally more labile abilities (such as receptive vocabulary) indicate environmental advantages. If environment does play a role, it will more likely be in terms of a very specific linguistic environment. For example, it has often been hypothesized that parents of children with Down syndrome speak inappropriately to them, perhaps pitching their speech at too high a level in light of the age of their child, or perhaps, at too low a level, being cognizant of the mental retardation (e.g., Cardoso-Martins et al., 1985; Jones, 1980). However, other studies suggest that parents speak to their children with Down syndrome much like they address normally developing children functioning at the same language level (Rondal, 1977). Similarly, despite its plausibility and popular appeal, the idea that variation in language input will explain differences in the acquisition of language structure has not received much support even in the normal case (e.g., Newport et al., 1977; Gleitman et al., 1984). Neither have input differences succeeded in explaining the phenomenon of specific language impairment in normally intelligent children (e.g., Johnston, 1988).

Environmental factors may play a role in explaining some of the variability in ultimate language function. Impoverished language input may create the language deficit to some extent, but enhanced language input may serve to ameliorate the difficulties (e.g., Meyers, 1988; Buckley, 1985). It may well be that some of the linguistically more advanced children benefit from particularly successful and appropriate interventions, but if adults are considered it is impossible to carefully determine the content (or even the fact) of relevant interventions retrospectively. Further systematic research in this area is critical.

The Role of Hearing Impairment in Explaining Language Deficits

A common explanation for the increased incidence of language problems in Down syndrome relates to the increased incidence of middle ear infection—and resulting hearing loss. Studies indicate that 40% of the Down syndrome population have mild hearing loss; 10–15% have a more severe hearing loss. Although hearing problems will surely exacerbate a problem in learning language, and must be treated, they do

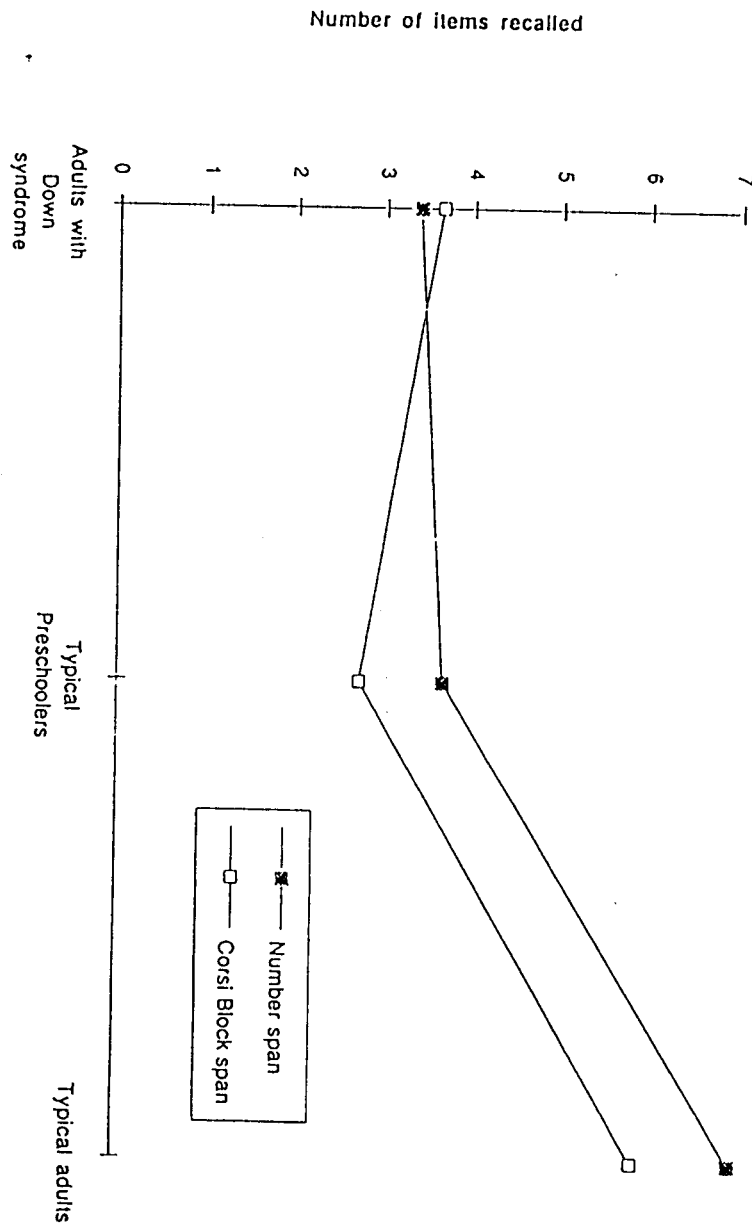


Fig. 1. Verbal and nonverbal memory span as a function of group.

not tell the whole story. In persons with Down syndrome, as in normally intelligent children with specific language impairment, language problems may also be evident even when no hearing problems are evident. Furthermore, even in samples of people with Down syndrome which do include those with hearing impairment, the pattern of language difficulty does not match the error patterns that typically stem from hearing impairment (Wisniewski et al., 1988). Finally, it should be noted that the many studies of otitis media and language impairment in children without Down syndrome have led to equivocal results at best (Kavanagh, 1986). In sum, although hearing impairment surely contributes to the language problem in the many persons with Down syndrome, it is unlikely to explain the whole problem.

Difficulties with Rule Learning

In an effort to understand why language structure was so difficult, Fowler (1988) and Fowler et al. (1993) looked closely at the language-learning process itself, including longitudinal studies in which children were visited on a monthly basis over many years. The hypothesis was that perhaps some specific inability to make linguistic generalizations such as "plurals are marked by a final morpheme *s*, the phonetic specification of which is to be determined by the final segment of the noun being marked" would be found. It was thought that children with Down syndrome might make shallow rather than deep generalizations, learning items piecemeal, rather than learning rules that applied across the lexicon. No evidence was found to support this hypothesis. Rather, two major conclusions were reached.

First, both the sequence of language development, and the structures acquired, are absolutely *normal*. Although, as mentioned above, syntax and vocabulary may get out of synchrony, no child has been known to simply skip over a step in the language-acquisition process. Similarly, despite numerous attempts to find evidence of deviant language structures, no unambiguous cases of deviance have been observed. Indeed, in several studies where the language output of persons with Down syndrome are matched with the output of normally developing youngsters half their age, the two are indistinguishable in all regards. This appears to be true at both low and high language levels.

Second, even the *rate* of development can be normal for periods (indicating acquisitions of a general rule) and yet lead ultimately to low language levels. Fowler et al. (1994) suggests that progress in language does not proceed at a slow continuous pace over childhood. Instead, it appears that progress is most rapid (and indeed can, for short periods, proceed at a near normal rate) from 4–7 years of age; these "spurts" are offset by long—sometimes interminable—periods where there is very little growth. What does characterize language learning in Down syndrome is inconsistent application of a rule after it has apparently been acquired. In the normal case, once the plural has been mastered, it is never deleted; in Down syndrome, the plural may be here today, gone tomorrow, and back again the following day.

In sum, persons with Down syndrome are not unable to acquire language rules, and when they do, the rules appear to take much the same form as in normally developing children. However, it does seem that many persons come to a point in

linguistic development where they cannot make the next forward step. It is also the case that they are unable to consistently maintain and apply the rules they have acquired.

A Shutdown in Development?

The findings might suggest that the extreme disparities between language structure and other aspects of cognitive function stem from a shutdown in the language learning sometime in middle childhood (see also Chapman, 1993). Although plateaus are often lengthy, it is not the case that language learning ceases altogether beyond that 4–7-year-old spurt. There is evidence for growth in language structure in late adolescence, years after any progress had taken place (Fowler, 1988). In a recent study looking at the interpretation of novel verbs (Naigles, Fowler, and Helm, in press), adolescents with Down syndrome applied in same strategies to interpret novel verbs as were used by very young children, demonstrating more linguistic flexibility than normal adults. From the clinical sector, too, there are reports that even older adolescents with Down syndrome are responsive to language intervention; both Meyers (1988) and Buckley (1993) report significant growth in grammatical morphology upon introduction to written language.

The Potential Role of Phonology in Explaining Deficits in Memory and Morpho-Syntax

The hypothesis currently being explored is that the difficulty so many people with Down syndrome experience in fully mastering the morpho-syntax of English may relate to more basic difficulties at the phonological level, both in *perceiving* speech and in *encoding* incoming acoustic information into a representational format that can be accurately, and readily, retrieved to serve memory, production, and comprehension. Because speech perception and articulation have been found to be closely related to phonological encoding in memory in the normal population, no attempt will be made to distinguish between them here. The general point is that verbal memory ultimately depends on the quality of phonological representations; if these are weak, phonological memory is compromised (Baddeley, 1986; Brady, 1991; Hulme and MacKenzie, 1992). Because much of grammatical knowledge is clued by acoustically nonsalient elements (Gleitman et al., 1988), it may be that phonological limitations (especially in perception) may lead to grammatical problems as well.

The hypothesis under investigation is that as phonological perception and production skills vary, so will verbal memory and grammatical-syntactic function. Although the phonological hypothesis is still new and largely untried as an explanation for linguistic weaknesses in Down syndrome, it is currently being pursued as an important explanation for language/memory deficits in normally intelligent children with specific language impairment (Gathercole and Baddeley, 1989), and in children with specific reading disability (e.g., Brady, 1991; Fowler, 1991; Liberman et al., 1989; Stanovich, 1988). Although the overall levels of function are higher in these groups, the shape of cognitive profiles (with verbal scores lower than nonverbal scores) is similar to the profile observed in Down syndrome.

Preliminary evidence suggests that variation in phonological skill may provide an important piece of the puzzle in Down syndrome as well. Not only are both memory and grammatical morphology relative weaknesses in Down syndrome, but there is evidence that each may stem from phonological deficits. For example, there is evidence for an important relation between more basic measures of phonology (e.g., articulation accuracy) and verbal memory (Racette, 1993). Similarly, a simple test of articulation correlated significantly [$r(31) = .73, p < .00001$] with the correct imitation of grammatical markers, a measure that, in turn, is an accurate index of language production. Although grammatical morphology was also related to general cognitive level [$r(31) = .40, p < .01$], the articulation scores explained an additional 37% of the performance in grammatical morphology over and above what had been explained by general cognitive level alone. Although there is much research to be done to explore possible links between perception, memory, grammar, and morphology, at least one study has observed a direct correlation between phonological and syntactic development in persons with Down syndrome (Crosley and Dowling, 1989).

If phonological factors are causally related to syntactic weaknesses, then intervention studies focusing on phonology should yield positive effects. Again, more research is required, but there is reason to believe that those intervention programs that are successful may be succeeding because they do enhance phonological salience. In normal children, the one factor in parental speech that enhanced grammatical development was a preference for making requests with an interrogative (Will you pick up your peas?) rather than imperative constructions (clean your room), thereby placing otherwise nonsalient verbal auxiliaries (will, have, are, is) into the front, stressed position. Children receiving this input produced verbal auxiliaries earlier than those hearing a preponderance of imperatives. Similarly, we would argue that these same auxiliaries can be rendered salient by presenting them in written form, as was done by Meyers (1988) and by Buckley (1985).

IMPLICATIONS

If language problems are to be relegated to the most fundamental aspects of perception, it might seem futile to even think about what might be done to facilitate language acquisition. However, having a better understanding of the source of the difficulty should aid immeasurably in the treatment. Some of the ramifications of current research on language learning, providing goals that parents and teachers should work together to attain, based on what we know to date are:

1. *Developmental normalcy.* Both the process and products of language learning in persons with Down syndrome appear to be normal in all respects. Therefore, communicate in a normal fashion, just as with all other children at that same language level.
2. *Keep the developmental sequence in mind.* Language learners are not going to skip a step, whatever the chronological age, so focus your efforts on the next challenge.

3. *Make the next step salient.* Hyperarticulate overlooked syllables and words in your own speech, use question commands, keep a close check on hearing.
4. *Signed language and written language will not interfere* with progress in spoken language, and may even aid it.
5. *Different domains within language proceed independently.* Feel free to push on one (articulation, reading, vocabulary, comprehension) even if progress in another (syntax, production) is currently stalled.
6. *Invest in speech therapy,* keeping in mind that articulation is more susceptible to training than syntax. It has its own merits for teaching, and will provide your child with a greater sense of power to be understood.
7. *Nurture forward progress,* especially during age 4–7, but remember that the potential for language growth continues into adulthood.
8. *Be easy on yourself.* The difficulties are genuine and each success is to be treasured.

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