

DETERMINANTS OR RATE OF LANGUAGE  
GROWTH IN CHILDREN WITH DS

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The questions addressed in this paper concern the effect of greatly impoverished general intellectual endowment on the acquisition of language structure over time, focusing upon children with Down Syndrome (DS). In asking this question, it is necessary to resolve two very well-documented findings regarding the language structures associated with DS. On the one hand, children with DS often have great difficulty acquiring language, generally showing delays relative to traditional motor, intellectual or social indices (Gibson, 1978). Indeed, it appears that children with DS may have even more difficulty in acquiring language structures than other subgroups of retarded children; this difficulty is most pronounced in the syntactic-grammatical domain (e.g. Burr and Rohr, 1978; see Fowler, in press for a review).

On the other hand, despite this marked difficulty in acquiring language structures, a sizable literature has consistently maintained that the products of this acquisition are "normal", with no hint of deviant learning processes. This robust conclusion is generally agreed upon regardless of the language level (e.g. Stage I versus Stage III); language area (e.g. vocabulary, semantic relations, syntax, or grammatical morphology) or language task (production or comprehension) under study. (For reviews, see Fowler, in press; Miller, in press; Rondal, 1975).

What these two findings suggest is a greatly slowed down, but normal, learning process. In this paper, the aim is to better understand the actual course of learn-

ing, paying particular attention to rate of development over time. Is learning slow and steady over time? Or does the child make insights over widely-spaced intervals? What are the relevant factors in accounting for rate of acquisition? In this study, the approach taken is longitudinal, adding to a heretofore extremely limited pool of data. Of special interest is the maturational hypothesis invoked by Lenneberg, Nichols and Rosenberger (1964) to account for the overall pattern of acquisition apparent in 63 children with DS studied over a three-year period. In brief, Lenneberg et al. suggested that language learning followed a timetable much like that assumed to underlie the unfolding of motor development; that IQ played but a minimal role in determining the prognosis of language skill; and that a critical period for language learning shut down with the onset of puberty, preventing further language growth in children whose acquisition was less than complete.

### *Background*

The research presented here and the hypothesis guiding it stem from work first presented in Fowler, Gelman and Gleitman (1980). In that initial study, we addressed the issue of language deviancy in children with DS showing massive delays in language skill. Specifically, 12 year old children with mental age (MA) scores of 5 to 6 years (Stanford-Binet) appeared to be speaking at the level of a normally developing toddler of 2.6 years. To pinpoint areas of differential difficulty in the retarded child, we matched groups on a global language measure -- mean length of utterance in morphemes (MLU) -- rather than on the then more standardly used MA score. We suspected that MA so vastly overestimated language skills as to mask any potential qualitative differences or any interesting discrepancies between skills, such as between closed class and open class vocabulary knowledge.

The results of that study were interesting on two counts. First, as indicated by comparative studies before and since, the language produced by the children with DS contained no hint of deviancy. Despite the advantage of general cognitive level and of impressionistic conversa-

tional skill, the children with DS performed remarkably like their MLU controls on a sizable battery of internal measures. They had made the same progress as their MLU peers in regard to the grammatical morphology; produced similar negative and interrogative forms; relied equivalently on open-class and closed-class vocabulary items; encoded similar thematic roles; and used similar sentence structures. In short, the two groups were at the same language stage. This finding is highly consistent with reports since from other labs.

The second conclusion of interest concerned the consistency of the language level observed across the four children with DS. The children with DS were not pre-selected for language level, but fell together as a natural class in our original observations of retarded children generally. Despite this fact, the analyses performed showed them to be operating with highly coherent, internally consistent grammars. Indeed, they were even more consistent than were the normally developing children, who were specifically selected for this language level from among a large number of youngsters between 30 and 36 months of age.

The particular language level observed, characterized as Stage III in Brown's (1973) schema of development, with a mean MLU of 3.0, allows for some primitive concatenation of phrases. It emphatically precedes the development of the verbal auxiliary system and of complex sentence subordination. We were led to ask why this particular stopping point, so consistently evident here and yet, from all reports including observations of our own, so rapidly traversed by the normally developing child.

Input from two other sources shed some potential light on the subject. First, a careful rereading of the available literature on the development of language in children with DS was undertaken, this time looking beyond the claims of normalcy to focus on what language structures the children with DS had acquired in absolute terms (Fowler, in press). The results of this review were startling: children with DS, by and large, do not progress beyond the language level (Stage III) attained by adolescents studied in Fowler et al. (1980). Several studies of language structure in DS have focussed on this stage (Rondal, 1980; Layton and Sharifi, 1979; Ryan, 1975,

1977). An even greater number of studies of language structure in DS have focused on stage I of language development; here one sees early two-word combinations characteristic of normally developing children from 18 to 24 months of age (e.g. Beeghly and Cicchetti, 1985; Coggins and Morrison, 1981; Rondal, 1980; Coggins, 1979; Dooley, 1977). The low levels characteristic of language in children with DS were not, of course, restricted to studies where MLU was the matching criterion. As pointed out by Rosenberger (1982), even the classic study of Lenneberg, Nichols and Rosenberger (1964), so often cited as testimony to the triumph of maturation over general cognitive disability in determining the course of language development, reported that a total of 3 out of 63 children studied had moved beyond the stage of "primitive phrases".

The second piece of data available to us was a quick trip to a younger classroom in the school from which we had derived our adolescent subjects. There, we found 7 to 9 year old children were using language seemingly indistinguishable from that spoken by our adolescents.

### *Hypotheses*

These data led to the formulation of three hypotheses regarding the course of language development in children with DS, and regarding the determinants of when progress occurs and when it will not. Hypothesis #1 is a stage-related hypothesis proposed to account for the consistency of language levels across children with DS, and the lack of movement beyond particular periods of development. According to Hypothesis #1 (a variant of proposals in the normal literature by Bowerman, 1982 or Karmiloff-Smith, 1979), language learning might best be characterized as a series of stages in which available information is reorganized and resystematized by learners -- retarded and not. Acquisition of a structure, or movement into a stage should require generalizations of the same scope, no matter who the learner. A child, who, either because of age or intellectual constraints, cannot acquire a structure or system in full, should stall altogether in the face of it. On the other hand, because a structure

can only be acquired in one form, once within a stage, groups should be indistinguishable. On this account, what should differentiate the retarded child is an extreme difficulty moving from one stage to another together with an early cutoff at a linguistically well-defined ceiling below some next more difficult and unattainable level of development.

Hypothesis #2, the "shallow generalization hypothesis" (Gleitman, 1981), is the implicitly assumed model of slow learning, that learning should be slowed down, uniformly and commensurately, relative to the normal case across the entire learning period. Under this view, language might proceed as a single accretion of facts over time and practice conditions. Rate of growth should be a direct function of IQ with flatter curves and shallower generalizations at all points. Hence, faced with the acquisition of a structure such as the past tense marker, the less well-endowed child might acquire the past tense marker for an individual subclass of verbs, or in the extreme case, verb by verb.

Each of these hypotheses, is, in turn, to be considered in light of yet a third hypothesis, Lenneberg's (1967) critical period hypothesis. Hypothesis #3 suggests that language learning in DS (and in individuals generally), is far more a function of general maturational factors (on a schedule with walking, running, etc.) than it is tied to general intelligence factors. A crucial component of Lenneberg's theory was the notion of a biologically imposed critical period of language development. Lenneberg's data, from work on DS and on aphasia, pointed to a shut-down of the specialized language learning faculty at puberty; such an account has also been invoked to explain effects of age on second language learning.

Two lines of longitudinal research are presented here to bear upon these competing hypotheses. Experiment I (presented in detail in Fowler, 1984) provides indepth data on one child, Rebecca, whose language development from Stage I to Stage V has been studied intensively, both for overall pattern of development and for internal acquisitions. Intensive study of Rebecca occurred between 51 and 89 months of age. Experiment II involves the comparison of Rebecca's overall developmental course with that of 10 other children with DS, varying in IQ and

chronological age at the onset of study. This larger data sample was collected over a 7 year period, and collectively spans the chronological age range of 4 to 19 years.

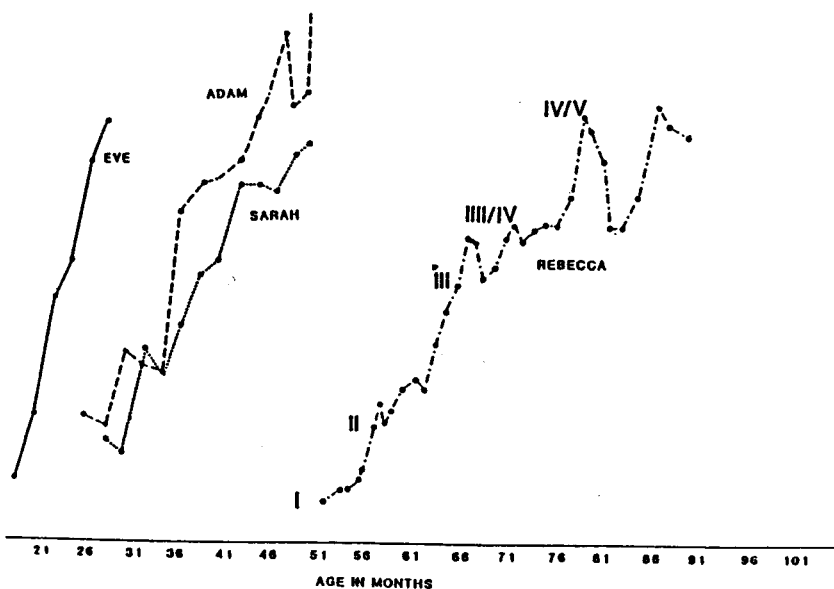
### *Experiment I*

Rebecca (Stanford-Binet 57) was selected for study at the age of 51 months, at which point she was in early Stage I, where Brown began his longitudinal study. She was observed in hour-long play sessions at home on a nearly-monthly basis from 51 to 89 months; since then her progress has been monitored at 6-month intervals (last visit 108 months). Procedures for collection, transcription and analyses of language samples were adapted from the classic normative studies of Bellugi (1967), Brown (1973), and Bloom (1970). The major findings are reviewed here to provide context for Experiment II.

Rebecca's development consisted of two quite distinct phases: Stage I to III; and Stage III and beyond. (See Figure 1). After a slow start in early Stage I, Rebecca proceeded from Stage I up to early Stage III (55 to 66 months) in an absolutely normal fashion. On all measures taken, her growth was unremarkable both in rate and character. This was true not only for the general measure of MLU, which progressed rapidly and consistently upward, but for internal measures as well. During this time, four of Brown's 14 grammatical morphemes (in, on, progressive and plural) were acquired to 90% criterion, the same four were the first acquired by each of Brown's three subjects within comparable language stages. Rebecca's early negative and interrogative constructions also paralleled normal development as set forth by Bellugi (1967), with a heavy reliance on intonation (I play this?, this is yours?); negative modals (I can't shut it), and the unadorned NOT (her not go). Present at this stage was a whole repertoire of unanalyzed wh-questions (e.g. where's NP?, what's this?). Encoding of thematic relations also advanced in an orderly fashion, although slightly in advance of other measures, when compared to normally developing subjects studied by Bloom, Lightbown and Hood (1975). Even the relative distribution of thematic cate-

gories relied upon was consistent with norms, with the only difference concerning a consistently greater tendency on Rebecca's part to pad her utterances with such non-developmental categories as stereotyped phrases, adverbs and vocatives. Finally, no unusual or persistent misanalyses were noted during the period from I to III.

Figure 1: Growth in mean utterance length of Rebecca (Down Syndrome) COMPARED TO THREE CHILDREN STUDIED BY BROWN (1973)



Once having achieved Stage III (MLU 3.5; 67 months), Rebecca's progress slowed sharply and began to deviate from the norm. Growth in MLU ceased altogether for 10 months and further gains were offset by large and erratic shifts downward. By the end of the study almost two years later (89 months), Rebecca had met the criterion for only one additional morpheme, the contractible copula. Even there, despite its consistent appearance in appropriate contexts (e.g. it's gone), the contractible copula also appeared in a wide variety of inappropriate contexts. Note, for example: "she's eat", "what's you want", "mommy's go water". This misanalysis appeared from the onset of Stage III and persisted to the end of the study (67 to 89 months). Other grammatical morphemes previously

acquired were now used inconsistently. Rebecca also plateaued at the Stage III level in terms of her progress in mastering questions and negation. The auxiliary system underlying mature constructions involving subject-auxiliary inversion and do-support were almost totally lacking in her grammar, with substantial progress apparent only at the final session. Between 67 and 89 months, a second misanalysis appeared, this time involving *wh*-terms. The term "what" frequently replaced other *wh*-terms to yield constructions like "what's you go" (meaning "where") and "What's you gonna bring it, Mom? 20 minutes?" (meaning "when").

The case of Rebecca bears interestingly upon the three hypotheses proposed. First, despite the fact that Rebecca has ultimately acquired more language skills than the adolescent children studied in Fowler et al. (1980), and than other children with DS generally, the changes in her developmental pattern which occurred at Stage III support the view that Stage III may indeed constitute a special blocking point for the child with DS; this is consistent with Hypothesis #1, the stage-related hypothesis of language acquisition. In contrast, Rebecca's course of development does not appear to be consistent with Hypothesis #2, the shallow generalization hypothesis. Under that hypothesis, one would have expected a slower progression across the period studied, rather than the sharp break between the near normal growth rate and the absolute plateau actually observed.

On the other hand, these data are also not inconsistent with Hypothesis #3, that age-related factors may account for Rebecca's change in growth rate as she reached school-age. Although not discussed in any detail by Lenneberg (1967), maturational growth curves need not be a simple case of normal rate of development up to a cut-off at puberty. That language is acquired more quickly -- and more readily -- in the pre-school years than in the middle childhood years is an idea that is gaining some currency from work with the deaf, a population which is of particular interest because of an all-too-frequent lack of exposure to any language during early childhood. Newport (1986) reports that deaf first exposed to a formal language model (ASL) during middle childhood show significant decrements in asymptotic skill in ASL when



compared to their luckier counterparts who learned ASL before five or six years of age.

### *Experiment II*

Subjects - To validate these findings on other subjects, we have now collected extensive longitudinal data on 10 other children with DS, differing widely in terms of IQ, starting CA, and language stage. Stanford-Binet IQ scores<sup>1</sup> in this group cluster around 50, but range from 38 to 64. Starting age ranged from 4 to 13 years; the sample includes the four adolescents first studied in Fowler et al. (1980). Although all the children had to be forming at least some two word combinations to be included in the sample, several of the children were well beyond Stage I when they were first interviewed. All children were tested at least once every six months for a minimum of four and a maximum of seven years. As in the case study of Rebecca, procedures for collection, transcribing, and coding of data followed canonical methods of classic normative studies. Taped conversations lasted a minimum of 30 minutes, yielding at least 100 child-initiated non-stock utterances.

Measures - The primary index of grammatical growth and complexity was the Mean length of utterance in morphemes (MLU), an optimal and standardly used measure of early language development, which has proven extremely useful in predicting other aspects of internal development in both normally developing children and in children with DS up to MLU 4.0 or approximately 3;6 years of age (e.g. Fowler, 1984; Brown 1973; Shipley, Smith & Gleitman, 1969). Procedures for calculating MLU were similar to those outlined by Brown (1973) with modifications as outlined and justified in detail in Fowler (1984). These modifications involved basing the analysis upon an entire session rather than just the first 100 utterances; and excluding from the analysis all elicited responses to questions, stock phrases (defined as any single expression occurring in identical form more than 5 times in a transcript), lists without internal structure (counting, naming friends, etc.), and immediate repetitions of self or other. This means differences in language use were

systematically removed from our analyses that we might focus on structural competence.

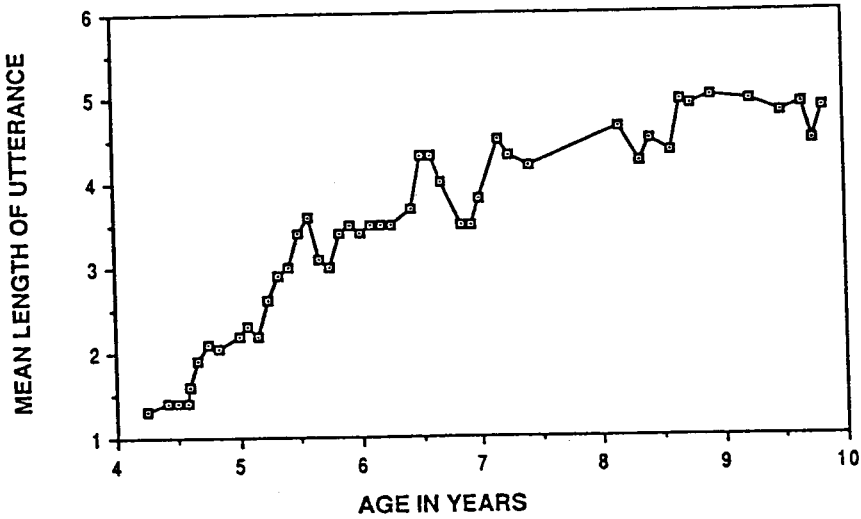
As a second, internal, measure of grammatical complexity, the Index of Productive Syntax (IPSyn - Scarborough, 1985) served to validate the MLU results as well as to aid in those cases where language development had progressed to the point where MLU was no longer reliable or valid (Scarborough, 1985; Chabon, Kent-Udolf, Egolf, 1982). The IPSyn is based on a 100 utterance sample and involves awarding points for the occurrence of 56 kinds of morphological and syntactic forms, for a maximum score of 112. The measure, based on a previous scale devised by Miller (1980), provides a quick quantitative means of detecting growth in internal language structure, for which norms are currently available on a total of 48 sessions collected from 12 children ranging from 24 to 48 months. The syntactic/morphological forms coded for are divided into four categories: Nounphrase, Verbphrase, Question/Negation and Sentence Structure, each with separate normed scores. Although this measure of optimal performance is not intrinsically tied to MLU, which is a measure of mean performance, Scarborough finds correlations of .72 to .96 between 24 and 36 months of age.

Use of the IPSyn measure with children with DS shows it to be convergent with the MLU measure in this population. This convergence is supported by a correlation of 0.95 between the two measures in Rebecca; this is made graphic in plots of growth for MLU and IPSyn presented together in Figure 2. (See Tager-Flusberg, 1986, for supporting results from other children with DS).

### *Analysis and Results*

As a first look at the data collected from the total sample of 11 children (including Rebecca), all MLU and IPSyn data points were entered into regression analyses calculating growth in these measures as a simple function of chronological age. As seen in Figure 3, the most obvious result of the analysis of growth in MLU is its non-linearity; using goodness-of-fit statistics, the first acceptable fit is a cubic. Although the overall linear slope is .11 MLU points a year, three distinct periods

Figure 2: Rebecca Total Growth in MLU



Rebecca Total Growth in IPSyn Measure

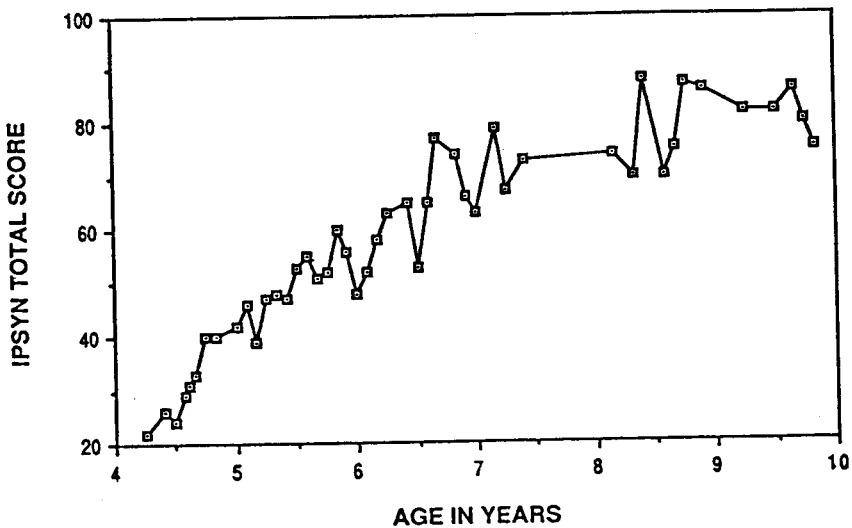
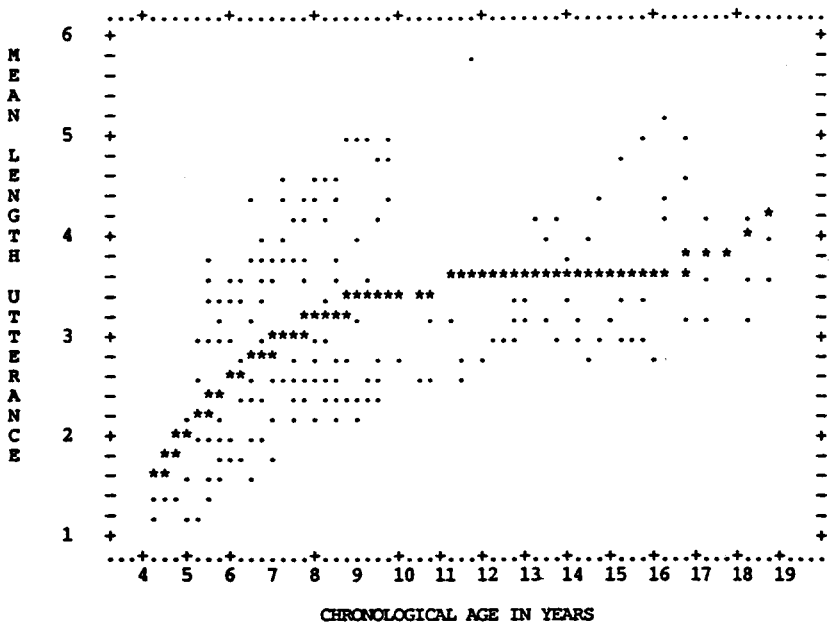


Figure 3: Growth in MLU as a function of age.

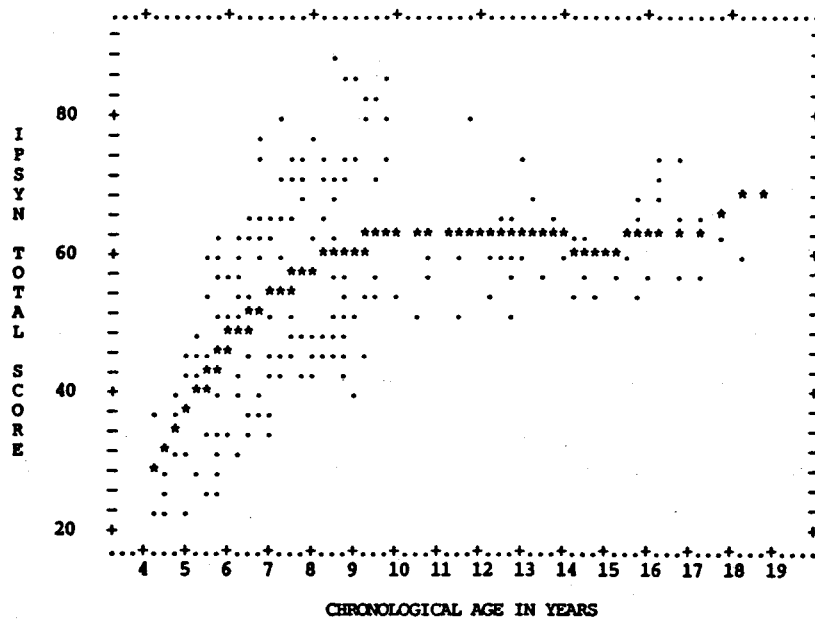


\* Data points weighted such that each child represented once in every 6 month interval during the years they were observed. Interpolations were made in those (few) instances in which an observation was not made in a particular 6 month interval.

reflecting different growth rates are indicated on this growth curve. Period I (MLU < 3.5; CA 4 to 8 years) is a period of relatively rapid growth with a linear slope of 0.48 MLU points per year. Period II (mean MLU 3.2; CA 8 to 15 years) is characterized by a plateau of no growth with a slope of 0.04. A third period (MLU 3.5 to 4.0; CA 13 to 19 years) reflects modest growth beyond puberty; linear slope is 0.06 MLU points per year.

The data presented in Figure 4 rely upon the same data sessions, but, in this case, reflect growth in IPSyn as a function of age. The pattern is very similar to that found for MLU growth, again suggesting three separate periods of growth. Period I is again characterized by

Figure 4: Growth in IPSyn as a function of age.



\* Data points weighted such that each child represented once in every 6 month interval during the years they were observed. Interpolations were made in those (few) instances in which an observation was not made in a particular 6 month interval.

relatively rapid growth, with a linear slope of 8.0 IPSyn points per year, compared to an overall slope of 1.6 per year. At age 8, just as with the MLU measure, growth in IPSyn virtually ceases, levelling off between 62 and 64. This IPSyn level, like the MLU score of the plateau, is just beyond the 30 month level described by Scarborough (1985). The extended plateau (linear slope = 0.3) lasts throughout middle childhood. The IPSyn measure also reveals a third period of growth beyond puberty; this slight upswing is reflected as an overall linear slope of 2.0 points per year.

Patterns of Development as a Function of IQ - Although the regression analyses presented in Figures 3 and 4 are

Table 1  
Mean MLU As a Function of Age and IQ<sup>a</sup>

	Lower IQ 38-48	Higher IQ 55-64
Younger (4 to 7 years)	1.94	3.00
Middle (7 to 12.6 years)	2.56	4.03
Older (12.6 to 19 years)	3.58	3.78

<sup>a</sup> This preliminary analysis is based upon all data points in the sample, with no weighting procedures applied.

Results of 2-way Analysis of Variance on these data

Age:  $F(2,207) = 71.06, p < .0001$

IQ:  $F(1,207) = 125.28, p < .0001$

Age x IQ:  $F(2,207) = 14.12, p < .0001$

consistent with both stage- and age-related hypotheses, the fit itself is quite bad. The correlation between predicted and observed points (R-squared) is only 0.32 for MLU and 0.44 for IPSyn. A better fit of the data was sought by separating children on the basis of IQ and/or CA. Such a division was justified by a preliminary two-way analysis of variance based upon the entire pool of data presented in Figure 3 (see Table 1). Observed MLU data points were classified according to IQ ("low" vs. "High" with a cutoff of 50) and CA at time of measure ("Young": 4 to 7 years; "Middle": 7 to 12.6 years; and "Older": 12.6 to 19 years). The results of this analysis revealed highly significant effects of CA and IQ as well as a significant CA x IQ interaction.

One seemingly anomalous result of this ANOVA is the finding that the mean MLU for the higher-IQ children is greater in the "middle" than in the "older" years. A more careful examination of individual curves indicated three

distinct groups of children among the 11 subjects analyzed. Whereas the growth patterns of different-aged lower-IQ children ( $n = 5$ ) converged to yield a single curve applicable across all of childhood (4 to 18 years), this was not the case for higher-IQ children, those scoring above 50 on the Stanford-Binet IQ test. The higher-IQ children entering the study before 7 years of age (IQ 56-64;  $n = 3$ ) were characterized by rapid early growth; all, for example, had already attained the 3.0 MLU threshold by 6 years of age; all had moved beyond that threshold by the close of the study. Other young children with DS observed by us and others (Tager-Flusberg, 1986; Beeghly and Cicchetti, 1986) also evidence this rapid early growth. However, higher IQ adolescents did not obviously fall into this subgroup. When first tested, at 10 to 12 year of age, their MLU scores (approximately 3.0) were markedly below the level achieved by two of the three younger higher-IQ children well before that time. Indeed, the pattern of these two older children with higher-IQ scores was not markedly dissimilar from the pattern observed for lower-IQ children overall. Because of the apparent mismatch between young and older subjects with IQ's over 50, we treat younger and older subjects separately, awaiting further data regarding the ultimate fate of the higher-IQ children followed from an early age. Although statistical comparison of group patterns is precluded by the small number of children per cell, the coherence within groups and differences across groups regarding developmental course are quite striking.

Effect of Chronological Age - Figures 6 through 8 portray averaged growth curves for the three chronological age growth periods emerging from the curve fitting procedures discussed above. For each of three phases, the two IQ groups are plotted separately in order to highlight the effect of IQ. In the earliest phase (4 to 8 years, CA, Figure 6), note that the six children in our sample began at the same MLU level. This was a function of subject selection procedures, which required only that the child show some evidence of two-word combinations. IQ data were not available at this age, due both to the difficulty of testing such young children and the policy of the school in which these children were then enrolled. Thus, they

Figure 5: Averaged growth in MLU in 11 children with DS.

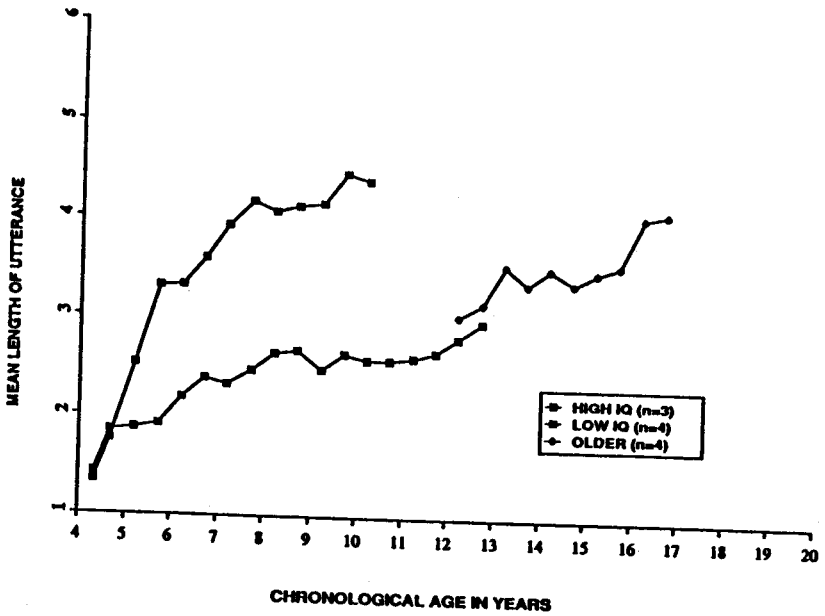


Figure 6: Growth in MLU in lower IQ children.

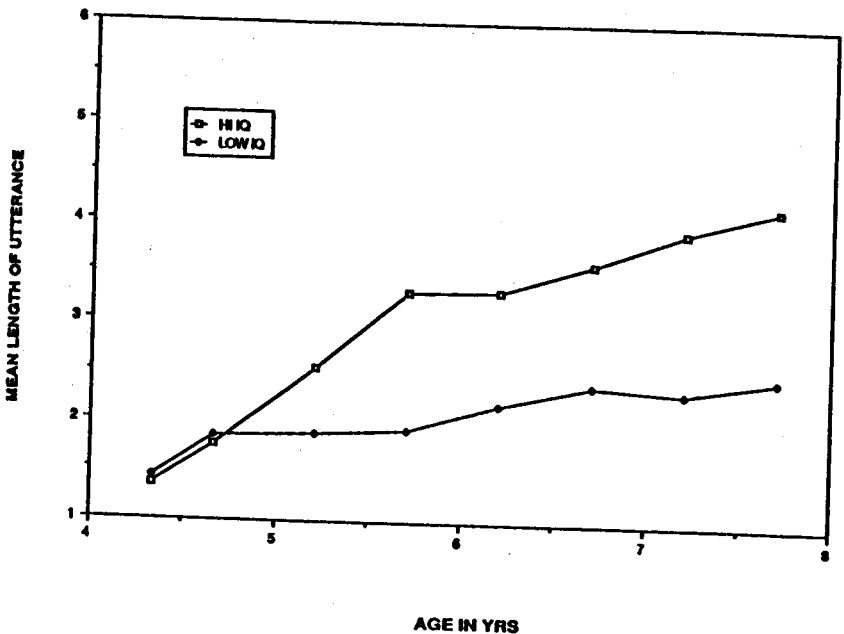
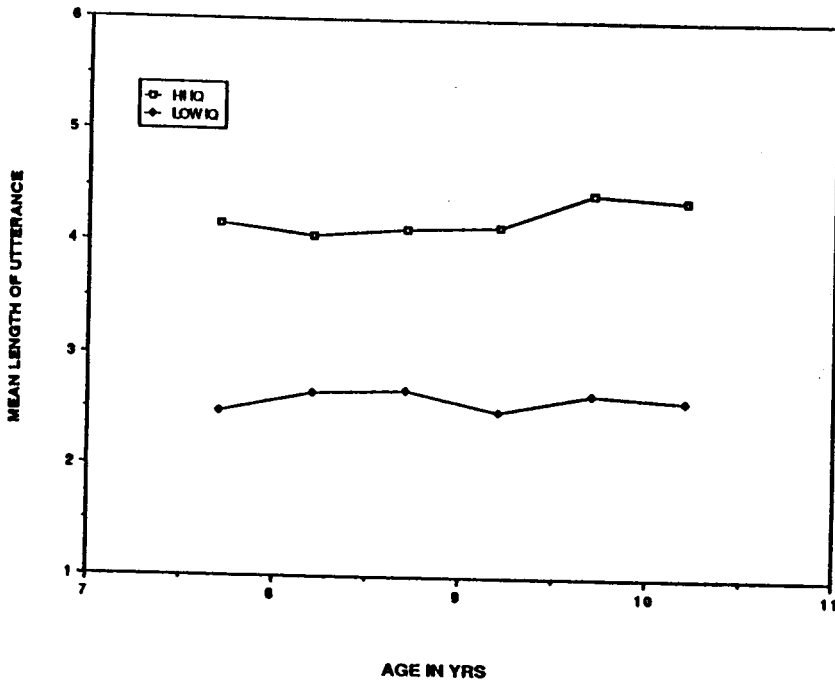




Figure 7: Growth in MLU for Higher IQ children (Younger).

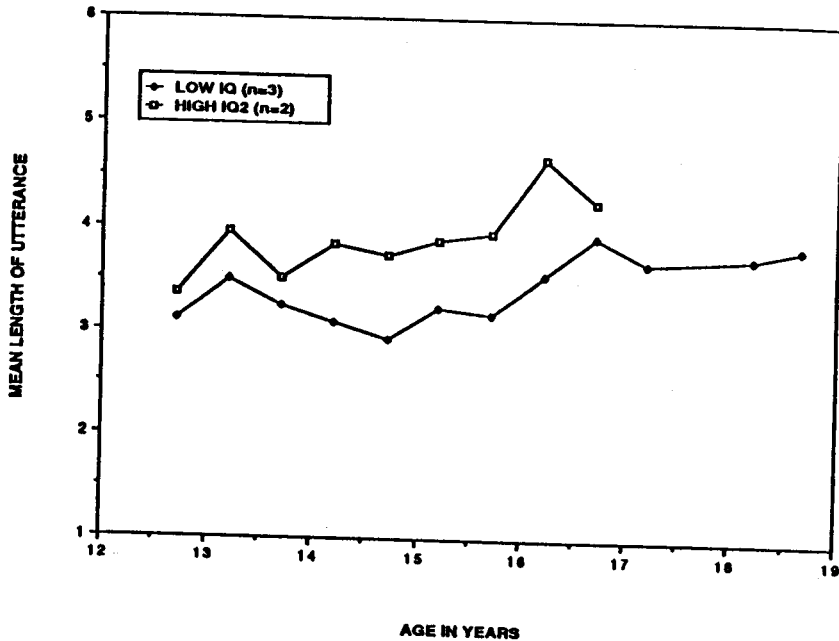


were treated as single group. Differences only emerged after age 5, when the higher-IQ group made and maintained rapid progress upward. Whereas the higher-IQ group continued to progress upward even after 6 years of age, monthly visits to the lower-IQ children (not yet labeled as such) yielded frustratingly small progress. Despite anticipation of a similar spurt in these children, progress remained slow throughout the early childhood period. Linear slope measures for the lower IQ children in this period was 0.28 points per year; the higher-IQ figure was 0.81.

As seen in Figure 7, between the ages of 7;6 and 10;6 years, rate of growth was near a standstill across the two IQ groups (lower-IQ slope in MLU = 0.07; higher-IQ slope = 0.15), despite substantial differences in absolute language level.

Effect of Language Stage on Rate of Growth - The evidence presented thus far, based upon averaged growth curves, points quite compellingly to a maturationally

Figure 8: Growth in MLU for higher IQ children (Older).



determined plateau in language growth in middle childhood. The effect of IQ is evident not so much in determining when these plateaus occur, but in how much growth actually occurs during critical periods of language growth. In this last section, individual growth curves are presented based on the raw data collected from each of the 11 subjects, suggesting that language stage too may make a significant contribution to language growth over and above the effects of CA and IQ. Much as was suggested in regard to Rebecca in Experiment I, there appear within an overall growth curve of an individual to be definable plateaus, with sharp -- if quite brief -- movements to an upper MLU point. These apparent language "stages" received considerable support on the basis of internal analyses in the case of Rebecca; similar analyses have been carried out on other children, though not in as great detail. For the present purpose of highlighting this pattern of development, only the MLU curves are presented for each of the 11 children studied. Plateaus apparent on the basis of lack of MLU growth (and fre-

quently supported by internal measures such as IPSyn) are indicated with straight lines on the growth curves pre-

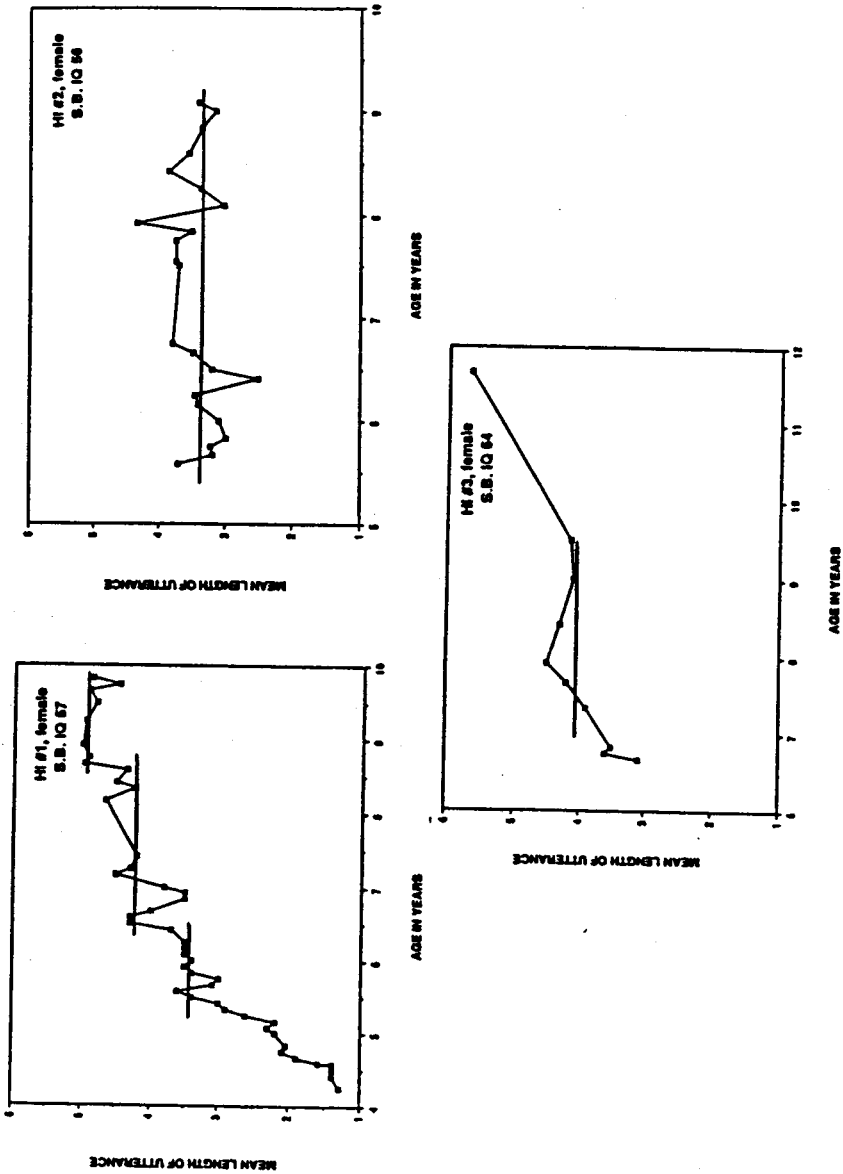
Table 2  
Growth in MLU - Individual Data

ID	S.B.	Age Studied	Mean	Range	Linear Slope
HI/#1	IQ57	4;3 to 8;10	3.33	1.30-5.0	0.68( $\pm$ .048)
HI/#2	IQ56	5;7 to 9;2	3.41	2.50-4.35	0.08( $\pm$ .072)
HI/#3	IQ64	6;8 to 9;6	3.93	3.10-4.50	0.30( $\pm$ .120)
LO/#1	IQ47	4;3 to 8;9	2.39	1.28-2.85	0.04( $\pm$ .048)
LO/#2	IQ48	4;11 to 8;8	2.40	1.67-3.06	0.24( $\pm$ .036)
LO/#3	IQ38	5;3 to 9;0	2.21	1.60-2.80	0.21( $\pm$ .048)
LO/#4	IQ48	7;5 to 12;7	2.61	2.26-2.97	0.09( $\pm$ .030)
AD/#1	IQ56	10;8 to 16;8	3.75	2.73-5.15	0.38( $\pm$ .048)
AD/#2	IQ55	12;3 to 18;3	3.47	2.90-4.19	0.07( $\pm$ .060)
AD/#3	IQ48	12;7 to 18;8	3.76	2.86-4.65	0.02( $\pm$ .036)
AD/#4	IQ44	12;8 to 18;8	3.76	2.70-3.55	0.07( $\pm$ .005)

sented in Figures 9 through 11. The criterion for definition as a plateau is that the slope of the curve defined within these points is significantly below that of the overall growth curve for the child.

At the outset of this group study, it was hypothesized that a plateau between 3.0 and 3.5 would be important in children with DS generally. Rebecca, studied in Experiment 1, spent 10 months at this level, corroborated by lack of internal growth measures. A second higher-IQ child (JH), studied at a similar age period as Rebecca, has spent four years at this level. Unfortunately, although the third child (KH) was at this level in our first two sessions with her, it is not known how long she had been at this stage prior to her participation in the study (see Figure 9). This plateau is even more evident in the lower-IQ, group, reaching an extreme in the case of GW, whose MLU remained virtually constant (3.0) between 12.6 and 19 years of age. The three other adolescent children in the study showed similar plateaus lasting for 3 to 7 years, but two had definitely moved beyond this level at 14 and 16.6 years, respectively (see Figure

Figure 9: Individual Growth Curves for Young Higher-IQ Children



11). The three youngest low-IQ children had not yet attained the 3.0 as they approached 10 years of age. The one child (KC) who has reached this age, however, does appear quite recently to have entered Stage III; on the basis of comparability of IQ, age, and internal measures, it appears that she, like GW, may remain at this stage indefinitely. (See Figure 10).

Although there is less relevant data speaking to plateaus at other language stages, extended lack of growth is apparent at MLU 2.5 in each of the four lower-IQ children studied between the ages of 4 to 12 (see Figure 10). Similarly, not all that far beyond the 3.0 - 3.5 threshold the growth patterns of Rebecca, KH, and the older adolescents do seem to indicate a second slow-down at MLU 4.0. Finally, although our data sampling procedures did not allow us to observe such an early plateau, there is substantial evidence in the literature, and emerging from current longitudinal research of Beeghly and Cicchetti (1986) and Tager-Flusberg (1986) to suggest a lengthy plateau at early Stage I development in the pre-school child with DS (see Dooley, 1977, for a compelling case study).

There are three sources of evidence supporting the view that these slowdowns constitute real plateaus in development. This thesis has been explored in the greatest depth in regard to Stage III. First, on the most general measures, e.g. MLU, mean growth rate within a stage is slower than overall growth rate for that child. That is, the child is not passing through that stage as through any arbitrary interval. As a rough index of this difference, mean slope measures for Stage III versus the overall growth rate are presented in Table 3, averaging the slopes of individual children for the relevant periods. Second, there is little evidence for internal growth within a period isolated on the basis of MLU growth patterns, as measured by the IPSyn measure, for example. One way of demonstrating this, which we are currently exploring, involves correlating CA with MLU or IPSyn both within and across stages. The hypothesis is that such correlations should be lower within stages than across stages (see Scarborough, 1985). The third piece of evidence speaking to stage-determined plateaus in development derives from data showing that the same MLU stage seems to have great

Figure 10: Individual Growth Curves for Young Low-IQ Children

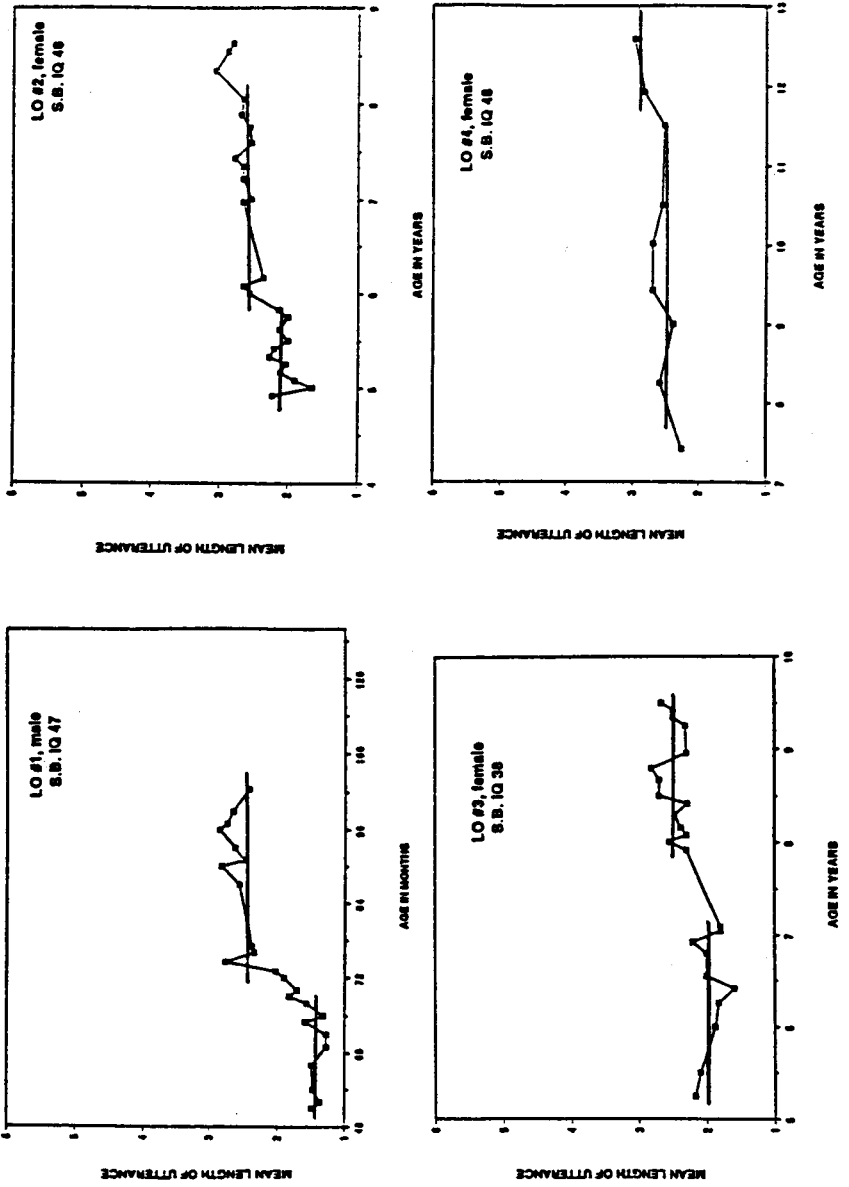


Figure 11: Individual Growth Curves for Adolescent Children

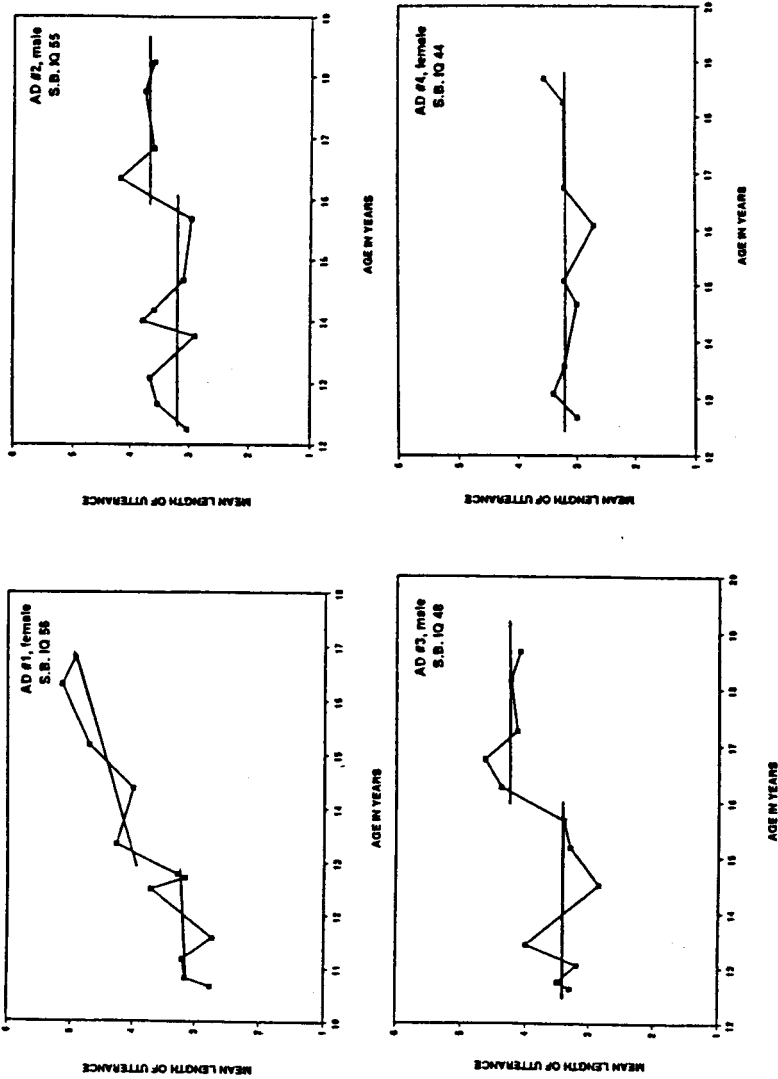


Table 3  
 Rate Of Growth In MLU as a Function of Language Stage  
 (Pts. of MLU Per Year)

	Stage III	Overall
Lower IQ	0.004 (+0.001)	0.015 (+0.008)
Higher IQ	0.012 (+0.027)	0.026 (+0.019)

coherence and consistency across children regardless of age or IQ level. As demonstrated in Fowler et al. (1980) and also supported by many other studies (see Fowler, in press; or Miller, in press; for reviews), this stage coherence cuts across both retarded and normal populations alike. On the basis of analyses to date, and based upon Rebecca and the older adolescents, there does appear to be considerable evidence that Stage III, at least, is a verifiable and internally coherent stage which serves as a very real and often extended stumbling block for many children with DS.

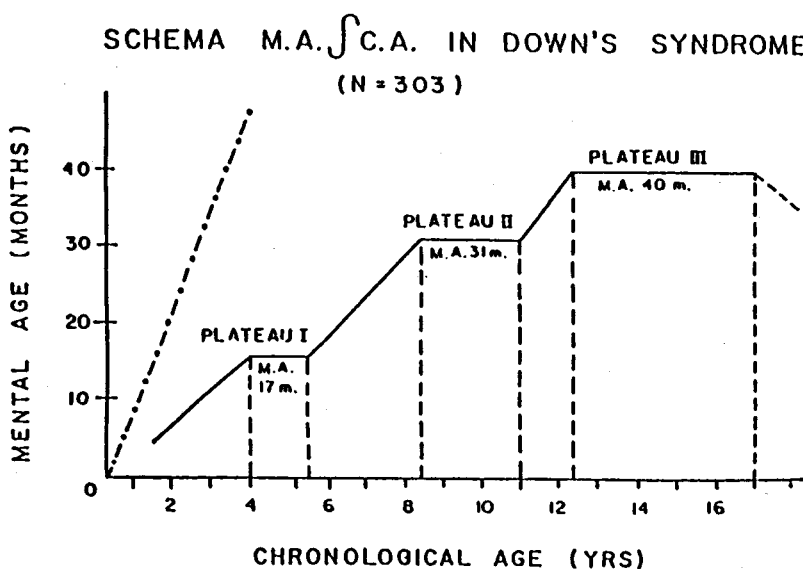
### *Discussion*

The purpose of the research presented here was to provide insight into learning processes leading to greatly delayed, but essentially "normal" language output characterizing the productions of children with DS. Although the sample is less than ideal for a definitive test of the hypotheses posed, multiple measures over extended periods of time upon a small, mixed group of children with DS have yielded some rather striking results. First, although the critical period as defined by Lenneberg (1967) would not accurately predict these particular growth curves, chronological age seems to exert considerable influence on the rate of language learning. Whereas Lenneberg suggested a cutoff at puberty, these data, and data from others (Rondal, personal communication) suggest that at least some children with DS make substantial progress in syntactic development during their teen-age



years. On the other hand, these data suggest a virtual halt in development during the middle childhood years. Interestingly, such a slowdown in middle childhood is also apparent in the growth curves of general intellectual development in DS, as presented by Gibson (1966) (see Figure 12). He reports a marked plateau at eight years of age, equivalent to mental age of 31 months. This is of interest not only because of the close correspondence in regard to CA, but also because a mental age of 31 months

Figure 12: Taken from Gibson, D. (1966), American Journal of Mental Deficiency.



corresponds well with the plateaued language level characterizing many of our subjects.

IQ, too, appears to play a substantial role in determining the prognosis of language learning in children with DS. Although the effects of chronological age remain apparent across the IQ-levels observed here, an IQ level greater than fifty seems critical to assuring substantial growth when maturational factors permit it. Lennberg (1967) suggests a similar IQ cutoff to explain differences of language level achieved in his subjects.

Although more internal analyses on the order of those which are provided for Rebecca in Experiment I are required to support a stage hypothesis in its strongest form, the data presented here support the position that language in DS may best be characterized by discrete periods of development, affected both by chronological age and by language stage. Growth in a child with DS, as in any normally-developing child, is not a steady accumulation of facts. Indeed, the data appear to suggest that the child with DS will provide insight into language stages that the normally developing child passes through at rapid speeds.

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#### *Footnotes*

1. To adjust for the known effect of chronological age on IQ scores in children with DS, we report the Stanford Binet assessment made nearest the child's 8th birthday.

## REFERENCES

- Beeghly, M., & Cicchetti, D. (1985). Development of functional communication during Stage I of syntactic development by children with Down syndrome. Presented at 10th Annual Boston University Conference on Language Development, October, 1985.
- Beeghly, M., & Cicchetti, D. (1986). Early language development in children with Down syndrome: A longitudinal study. Presented at 11th Annual Boston University Conference on Language Development, October, 1986.
- Bellugi, U. (1967). The acquisition of negation. Unpublished doctoral dissertation, Harvard University.
- Bloom, L. (1970). Language development: form and function in emerging grammars. Cambridge, MA: MIT Press.
- Bloom, L., Lightbown, P., & Hood, L. (1975). Structure and variation in child language. Monograph of the Society for Research in Child Development, 40(2).
- Bowerman, M. (1982). Reorganizational processes in lexical and syntactic development. In E. Wanner and L. R. Gleitman, (Eds.), Language Acquisition: State of the Art. Cambridge MA: Cambridge University Press.
- Brown, R. (1973). A first language. Cambridge, MA: Harvard University Press.
- Burr, D. B., & Rohr, A. (1978). Patterns of psycholinguistic development in the severely retarded: A hypothesis. Social Biology, 25, 15-22.
- Chabon, S., Kent-Udolf, C., & Egolf, D. (1982). The temporal reliability of Brown's Mean Length of Utterance (MLU-M) measure with post-Stage 5 children. Journal of Speech and Hearing Research, 25, 117-124.
- Coggins, T. E. (1979). Relational meaning encoded in the two-word utterances of Stage 1 Down's Syndrome children. Journal of Speech and Hearing Research, 22, 166-178.
- Coggins, T. E., & Morrison, J. A. (1981). Spontaneous imitations of Down's Syndrome children: A lexical analysis. Journal of Speech and Hearing Research, 46, 303-308.
- Dooley, J. (1977). Language acquisition and Down's Syndrome: A Study of Early Semantics and Syntax. Unpublished doctoral dissertation, Harvard University.
- Evans, D. (1977). The development of language abilities

- in mongols: A correlational study. Journal of Mental Deficiency Research, 21, 103-117.
- Fowler, A. (in press). The acquisition of language structure in children with DS. To appear in D. Cicchetti & M. Beeghly, Down Syndrome: The Developmental Perspective, Cambridge MA: Cambridge University Press.
- Fowler, A. (1984). Language acquisition in Down's Syndrome children: Production and Comprehension. Ph.D. dissertation, University of Pennsylvania.
- Fowler, A., Gelman, R., & Gleitman, L. (1980). A comparison of normal and retardate language equated on MLU. Presented at the 5th Annual Boston University Conference on Child Language Development.
- Gibson, D. (1966). Early developmental staging as a prophecy index in Down's Syndrome. American Journal of Mental Deficiency, 70, pp. 825-828.
- Gibson, D. (1978). Down's Syndrome: The psychology of Mongolism. London: Cambridge University Press.
- Gleitman, L. R. (1981). Maturational determinants of language growth. Cognition, 103-114.
- Karmiloff-Smith, A. (1979). Language as a formal problem space for children. Paper presented at Beyond Description in Child Language. Max Planck Gesellschaft, Nijmegen, The Netherlands.
- Layton, T. L., & Sharifi, H. (1979). Meaning and structure of Down Syndrome and non-retarded children's spontaneous speech. American Journal of Mental Deficiency, 83, 439-445.
- Lenneberg, E. H. (1967). Biological Foundations of Language. New York: Wiley.
- Lenneberg, E. H., Nichols, I. A., & Rosenberger, E. F. (1964). Primitive stages of language development in mongolism. Research Publications, Association for Research in Nervous and Mental Disease, 42, 119-147.
- Miller, J. F. (1980). Assessing language production in children: Experimental procedures. Baltimore: University Park Press.
- Miller, J. F. (in press). Language and communication characteristics of children with Down syndrome. In A. Crocker, S. Pueschel, J. Rynders, & C. Tinghey (Eds.), Down Syndrome: State of the Art. Baltimore: Brooks Publishing.
- Newport, E. (1986). Paper presented at the 11th Annual

- Boston University Conference on Child Language.
- Rondal, J. A. (1975). Developpement du langage et retard mental: Un revue critique de la litterature en langue anglaise. Annee Psychologique, 75, 513-547.
- Rondal, J. A. (1980). Verbal imitation by Down Syndrome and nonretarded children. American Journal of Mental Deficiency, 85, 318-321.
- Rosenberg, S. (1982). The language of the mentally retarded: Development, processes and intervention. In S. Rosenberg (Ed.), Handbook of Applied Psycholinguistics. Hillsdale, NJ: Erlbaum.
- Ryan, J. (1975). Mental subnormality and language development. In E. Lenneberg and E. Lenneberg (Eds.), Foundation of Language Development, Vol. 2, New York: Academic Press.
- Ryan, J. (1977). The silence of stupidity. In J. Morton and J. C. Marshall (Eds.), Psycholinguistics: Developmental and Pathological. Ithica, NY: Cornell University Press.
- Scarborough, H. S. (1985). Measuring syntactic development: The Index of Productive Syntax, Presented at the Biennial Meetings of the Society for Research in Child Development, Toronto.
- Shipley, E., Smith, C., & Gleitman, L. (1969). A study in the acquisition of language: Free responses to commands. Language, 45, 322-342.
- Tager-Flusberg, H. (1986). Paper presented at the 11th Annual Boston University Conference on Child Language.