ACEC-63C EFIC REPORT RESUME

EC C1C C47 1C-C5-66 24 (REV)

SENTENCE STRUCTURES USED BY SUPERIOR STUDENTS IN GRADES FOUR AND TWELVE, AND BY SUPERIOR ADULTS.

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BR-5-C313
EDRS PRICE MF-$C.18 HC-$3.6C 90P.

*WRITING SKILLS, COMPOSITION (LITERARY), LANGUAGE ARTS, *CHILD DEVELOPMENT, SUPERIOR STUDENTS, MEASUREMENT INSTRUMENTS, *STUDY CHARACTERISTICS, *MATURITY TESTS, *GRAMMAR, AGE DIFFERENCES, MENTAL DEVELOPMENT, ADULT PROGRAMS, TWELFTH GRADE, FOURTH GRADE, TALLAHASSEE, FLORIDA

THE SEARCH FOR QUANTITATIVE MEASURES IN SENTENCE STRUCTURES THAT ARE SIGNIFICANT INDICATORS OF CHRONOLOGICAL AND MENTAL MATURITY IN SCHOOL CHILDREN WAS THE PURPOSE OF THIS STUDY. COMPARISONS WERE MADE OF COMPOSITIONS WRITTEN BY STUDENTS OF SUPERIOR IQ AT THE SAME GRADE LEVELS. THIS PART OF THE PROJECT HAD TWO OBJECTIVES--(1) TO SEE WHETHER SUPERIOR STUDENTS NEAR THE BEGINNING OF THEIR WRITING CAREERS ARE ALREADY MEASURABLY AHEAD OF THE AVERAGE STUDENTS IN SYNTACTIC MATURITY, AND IF SO IN WHAT RESPECTS, AND (2) TO DETERMINE WHETHER SUPERIOR STUDENTS NEAR THE END OF THEIR PUBLIC SCHOOL TRAINING ARE FURTHER AHEAD OF THEIR AVERAGE COUNTERPARTS. ANOTHER COMPARATIVE EXERCISE WAS CONDUCTED BETWEEN THE SYNTACTIC WRITTEN STRUCTURES OF SUPERIOR AND AVERAGE TWELFTH-GRADERS WITH THOSE OF SKILLED ADULTS PUBLISHED IN "HARPERS" AND "ATLANTIC" MAGAZINES. THIS SECOND PROJECT TASK WAS CONDUCTED TO DETERMINE WHETHER TWELFTH GRADERS (AT LEAST SUPERIOR ONES) HAVE ALREADY ATTAINED FULL SYNTACTIC MATURITY OR WHETHER, INSTEAD, SKILLED ADULT WRITERS ARE AHEAD OF THEM, AND IF SO, IN WHAT RESPECTS. IN GENERAL, THE RESULTS OF THE STUDY SHOWED DEFINITE DEVELOPMENTAL TENDENCIES OCCURRING BETWEEN GRADES 4 AND 12 AND CARRYING EVEN FARTHER IN THE WORK OF SKILLED ADULTS. THUS, THE MEASURES EMPLOYED WERE DEEMED SUFFICIENTLY SENSITIVE TO DETECT MENTAL, AS WELL AS CHRONOLOGICAL, MATURITY. THE STUDY WAS AN EXTENSION OF COOPERATIVE RESEARCH PROJECT 1998, ENTITLED "DIFFERENCES IN GRAMMATICAL STRUCTURES WRITTEN AT THREE GRADE LEVELS." (JH)

SENTENCE STRUCTURES USED BY SUPERIOR STUDENTS IN GRADES FOUR AND TWELVE, AND BY SUPERIOR ADULTS

COOPERATIVE RESEARCH PROJECT NO. 5-0313

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The research reported herein was supported by the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education, and Welfare.

TABLE OF CONTENTS

TABLE OF CONTENTS--continued

TABLES

CHAPTER 1. IMPROVING SYNTACTIC MEASURES AND APPLYING THEM TO SKILLED ADULTS

1-1. The problem

The general purpose of CRP 5-0313 is to study the syntactic development of school children, using quantitive measures. As we learn what changes occur over the years we may be able to devise teaching methods which will encourage that change and hasten that growth.

1-2. The purpose

1. For this study, one purpose is to continue the search for quantitive syntactic measures that are significant indicators of the chronological maturity and mental maturity of school children.

2. A second purpose is to compare the syntactic structures written by students of superior IQ in grades 4 and 12 with those used by students of average IQ at the same grade levels.

One purpose for comparing the two groups of fourth graders is to see whether students of superior IQ near the beginning of their writing careers are already measurably ahead of students of average IQ in syntactic maturity, and if so in what respects.

Whatever syntactic differences occur may be attributed to differences in mental maturity.

The purpose for comparing the two groups of twelfth graders is similar, but, in addition, to see whether superior students near the end of their public school training are farther ahead of their average counterparts than superior fourth graders are. Does the gap widen with the years?

3. A third purpose is to compare the syntactic structures written by twelfth graders of superior and average IQ with those written by skilled adults in Harpers and Atlantic.

The purpose of this comparison is to see whether twelfth graders, at least highly superior ones, have already attained full syntactic maturity or whether, instead, skilled adult writers are still ahead of them, and if so, in what respects.

Obviously, the finding of significant differences between students known to differ in chronological maturity and in mental maturity tells us not only something about the students, but it also proves the validity of the measures employed for that purpose. The purpose of this study, then, is not only to measure the writers, but also, reciprocally, to measure the measures.

1-3. Related research

This study is an extension of Cooperative Research Project 1998 by the same investigator. The title of that study was Differences in Grammatical Structures Written at Three Grade Levels. It was completed in June of 1964, and will be referred to in this study simply as CRP 1998.

The writings studied there were by children of average IQ (90 - 110 on the California Short Form) in grades 4, 8 and 12. Those same writings from grades 4 and 12, though with certain deletions to be explained in a later section, will be compared in this study with the writings by students of superior IQ in grades 4 and 12.

Some parts of the present report have been already printed in Research Report #3 of the National Council of Teachers of English. That report is a re-written version of CRP 1998 together with certain of the new findings. The title is Grammatical Structures Written at Three Grade Levels.

1-4. Measures of syntactic maturity before CRP 1998

One of the aims of CRP 1998 was to search for better measures of syntactic maturity. For thirty years various developmental studies had tabulated (1) the mean length of sentences, (2) the mean length of clauses, (3) the proportion of dependent (or subordinate) clauses to main clauses, and (4) the relative frequency of the commonest kinds of dependent clauses: noun clauses, adjective clauses, adverb clauses.

The conclusions that were drawn from such studies were summarized a decade ago by Dorothea McCarthy in a classic passage.

1-5. McCarthy's summary a decade ago

McCarthy's summary concerning sentence length, clause length, the frequency of subordinate clauses, made three points:

1. As a measure of syntactic maturity, sentence length is the most widely used index of linguistic maturity. Its virtues are objectivity and reliability, a certain amount of validity, and ease of application.

2. Clause length remains "fairly constant" in grades 4 to 12. It is in the nature of language that clause length does not increase as children mature.

3. Sentence length increases as children mature because they learn to add more subordinate clauses. Adding more clauses is what lengthens sentences.

McCarthy's language is as follows:

> Apparently, then, sentence length is a measure which continues to show increase up until maturity. The use of the measure has been criticized by some writers and a few substitute measures have been suggested, but none seems to have superseded the mean length of sentence for a reliable, easily determined, objective, quantitative, and easily understood measure of linguistic maturity....
>
> It is interesting to note from [LaBrant's] study, however, that length of clause remains fairly constant in Grades 4 to 12, although the subordination index, or ratio of subordinate to coordinate clauses, shows an increase. Apparently length of clause is somewhat controlled or restricted by the structure of the language, and whatever increase in sentence length occurs at higher age levels is brought about largely through the addition of more subordinate clauses.[1]

Whether or not these beliefs are supportable in view of more recent research will be discussed later.

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[1]McCarthy, Dorothea. "Language Development in Children," in Manual of Child Psychology, Ed. Leonard Carmichael. New York: John Wiley & Sons, Inc., 1946, pp. 522-3.

1-6. Four of the measures of syntactic maturity used in CRP 1998

The purpose of CRP 1998 was to search for new insights and understandings about syntactic maturity and to search for new quantitative measures.

The writings selected for study in CRP 1998 were from grades widely spaced along the school years: from grade four where children are just beginning to write with a degree of comfort and ease; from grade twelve where they are finishing their public schooling; and from grade eight, halfway between. Roughly those three grades represent the beginning, middle and end of public school writing development. Only students of average IQ scores were chosen, 90 to 110. Nine boys and nine girls were studied from each grade, and each student was represented by a thousand words, so the total corpus was 54,000 words, from 54 students, 18 in each of three grades.

Though one purpose of the study was to search for new measures and new understandings of syntactic development, the study began by applying three of the conventional measures: mean sentence length, mean clause length, and the subordination ratio. These three measures were applied to the writing of each student, and additional means were computed for each grade and each sex within grade.

It was found that the mean length of sentences does increase with statistical significance at the .05 level. But as a measure of individual achievement that measure leaves much to be desired, for one eighth grader wrote sentences nearly twice as long as those by the average twelfth grader, and one fourth grader wrote sentences longer than any one of the twelfth graders. These younger students

were not precocious; they either strung their sentences out to prodigious length by using and after and after and, or they strung them out without even using and's, merely running them together. They wrote long sentences because they had not yet learned to punctuate maturely with periods.

Fourth graders were found to use nearly five times as many and's between main clauses as twelfth graders did. But the number of and's and other coordinators between main clauses does not give a measure of the number of run-together sentences, and running sentences together without coordinators is a significant way that immature students may write longer sentences than mature students. So CRP 1998 thus lacked an adequate measure of this tendency, but this lack has been remedied since then, and the remedy will be reported later when the synopsis of the five factors relating clause length to sentence length is discussed.

Another measure which has been used for a least thirty years in syntactic development studies is that of mean clause length. In CRP 1998 any expression containing a subject (or coordinated subjects) and a finite verb (or coordinated verbs) was counted as one clause. Often it is not possible to count the number of words in a single clause because one clause is often part of another, but in any passage, whether as short as a sentence or as long as a book, it is always possible to count the number of words and the number of clauses and divide one figure by the other to get the mean. Thus in the sentence, "He said I ought to keep quiet," there are seven words and two clauses, so the average clause length in this tiny sample is three and a half

words. The fact that the second clause is direct object of the first, and hence part of it, is no obstacle to this measurement of mean length.

The mean clause length of students in the three grades was found to increase, and to do so with a higher level of significance than for sentence length: that is, at the .01 level rather than at the .05 level.

A third conventional measure that has been used for at least thirty years is usually called the "subordination ratio." It measures the proportion of subordinate clauses to main clauses and happens to be expressed usually as the number of subordinate clauses divided by the number of all clauses both subordinate and main.

The mean subordination ratio for each grade was found to increase with maturity and with a significance at the .01 level. This level of significance exceeds that for sentence length, just as the significance of clause length does.

CRP 1998 then investigated a new syntactic measure. The investigator reasoned that if clauses get longer with maturity, and if the frequency of subordinate clauses per main clause also increases with maturity, then the syntactic units which consist of one main clause plus whatever number of subordinate clauses happen to be attached to or embedded in that main clause will increase too, and the increase can be expected to result from both tendencies and can be expected to exceed that for either tendency by itself. To verify this expectation, the entire 54,000 words was segmented into such units.

To illustrate the process of segmentation, here is a theme as it was written by a fourth grader. It was written as one sentence and consists of 68 words.

> I like the movie we saw about Moby Dick the white whale the captain said if you can kill the white whale Moby Dick I will give this gold to the one that can do it and it is worth sixteen dollars they tried and tried but while they were trying they killed a whale and used the oil for the lamps they almost caught the white whale

Here is the same theme segmented into these units which consist of one main clause plus whatever subordinate clauses happen to be attached to or embedded within it. Each unit is repunctuated here with a capital letter and a period.

1. I like the movie / we saw about Moby Dick, the white whale.
2. The captain said / if you can kill the white whale, Moby Dick, / I will give this gold to the one / that can do it.
3. And it is worth sixteen dollars.
4. They tried and tried.
5. But / while they were trying / they killed a whale and used the oil for the lamps.
6. They almost caught the white whale.

It will be seen that each unit is a grammatically complete sentence and, secondly, that these are the shortest units into which the passage can be segmented without creating sentence fragments.

For lack of a better name, these units were christened "minimal terminable units," "terminable" because it is grammatically allowable to terminate them, like sentences, with a capital letter at one end and a period or other terminal mark at the other; and "minimal" in the sense that they are the shortest units into which a passage can

be thus segmented without leaving fragments as residue. For short, "minimal terminable units" will be referred to hereafter simply as "T-units."

The expectation that such units would be a significant index of maturity was confirmed. The significance was found to be at the .01 level.

The majority of sentences consist of just one T-unit. "Simple" sentences and "complex" sentences do. The other sentences, the "compound-complex" sentences, consist of two or more T-units coordinated into one sentence.

The T-unit is an objective and unambiguous unit. Grammarians easily agree on what is a main clause, and they easily agree too on which dependent or subordinate clauses go with which main clauses.

T-unit length was studied in a variety of ways. The entire 54,000 word corpus was segmented into T-units, and the length of each one was tabulated so that, for each grade, a graph could be plotted showing the number of T-units of each length. Various other ways were employed to describe the differences from grade to grade, but these need not be reviewed here.

Of the four syntactic maturity measures employed in CRP 1998, three were conventional and one was new. Which are most valid? Each is objective, each is reliable.

When the score for each individual on each measure is plotted, it becomes immediately apparent that T-unit length is the measure most successful at separating grades with a minimum of overlapping.

Or if the score for each individual on each of the four measures is subjected to a chi square and contingency coefficient analysis,

again we find that of the four measures for grades 4, 8 and 12, the most valid measure of maturity is T-unit length. Second best is clause length. Third best is subordination ratio. Least valid of all is sentence length.

1-7. An improved method for relating clause length, T-unit length and sentence length

Although CRP 1998 did introduce the concept of the T-unit, and proved it to be a better index of syntactic maturity throughout the school grades than the conventional measures previously employed, that study did not make full use of the T-unit as a device for relating clause length to sentence length in an orderly arithmetical progression. An explanation of that relationship will now be given, first of the relation between T-unit length and the length of the smaller unit, the clause. Then the relation between T-unit length and the length of the longer unit, the sentence, will be discussed.

Already it has been observed that a unit possessing exactly one main clause with an indefinite number of subordinate clauses can be lengthened in either or both of two ways: by lengthening the clauses either subordinate or main, or by increasing the number of subordinate clauses attached to the one main. The first method of lengthening is already measured by mean clause length. The second is already measured indirectly by subordination ratio.

But since each T-unit has exactly one main clause, another way to describe the second method for lengthening T-units would be to speak of increasing the number of subordinate clauses within the one T-unit. And another way to measure that increase would be through the

number of subordinate clauses per T-unit. But a more convenient measure is, instead, the number of clauses (both subordinate and main) per T-unit. That measure is convenient because it provides an arithmetical bridge between clause length and T-unit length. For any body of writing whether as long as a book or as short as a sentence, the clause length (number of words divided by number of clauses) multiplied by this new ratio (number of clauses divided by number of T-units) equals T-unit length (number of words divided by number of T-units).

This ratio is not recommended as being a more valid index of syntactic maturity than the old "subordination ratio," but only as a more convenient one. It is easily computed, because it requires no new analysis and no new counts beyond those required anyway for obtaining clause length and T-unit length. To get all three measures one needs to know the total number of words, and of clauses, and of T-units for the passage being measured.

The meaning of the proposed ratio is immediately readable: the number will never be less than one, for there is always just one clause, a main clause, in any T-unit; so however much the ratio exceeds 1 will indicate the average number of subordinate clauses in that T-unit. A score of 1.5 means that .5 of the time a subordinate clause is attached to a main clause. A score of 2 means that on the average a T-unit has one subordinate clause in addition to the inevitable main clause.

Since the largeness or smallness of this index varies only with the number of subordinate clauses, the obvious name is "subordinate clause index." This name, of course, is likely to be confused with

the "subordination ratio." The one figure is convertible to the other arithmetically, for one is the number of clauses both subordinate and main divided by the number of main clauses; the other is the number of subordinate clauses divided by the number of clauses both subordinate and main.

Just as the ratio of the clauses to T-units or "subordinate clause index" is a convenient arithmetical bridge for relating clause length to T-unit length, so there is another ratio which conveniently serves as an arithmentical bridge between T-unit length and sentence length. That ratio is the number of T-units per sentence. A fairly accurate name for it might be "main clause coordination index." Actually it is one whole T-unit that is coordinated with another whole T-unit, but grammarians usually speak as if only the main clauses were coordinated, for they have had no term for what is here called the T-unit. "T-unit coordination index" is another name which might be used.

This index is easily computed. For any passage, whether as short as a sentence or as long as a book, this index is simply the total number of T-units divided by the total number of sentences. The meaning of the ratio is immediately readable: the number will never be less than 1, for there is always one T-unit in a sentence. The amount by which the number exceeds 1 indicates the average number of other T-units added to that first one. A score of 1.5 means that .5 of the time a second is coordinated to the first. A score of 2 means that on the average one more is added to the first.

Obviously there are two ways to lengthen sentences: one is to write longer T-units, the other is to write more T-units per sentence.

As will be seen presently, one way is characteristic of mature writers, but the other, though employed by mature writers too, is more often employed by the immature.

The need for this index or ratio was already apparent in CRP 1998. There it was observed that some younger students lengthened sentences prodigiously by using and after and after and. The number of and's between main clauses is a fairly adequate measure of that tendency. But younger students also lengthened sentences prodigiously by simply running them together, without even and's between, and no measure of that tendency was used in CRP 1998.

In CRP 1998 it could be said that T-unit length was proved to be a more valid index of maturity than sentence length, and the reason for that difference could be conjectured to be that some younger students lengthened their sentences--perhaps "artificially" or "fallaciously" but certainly "immaturely"--by excessive and's and run-ons. However, no direct index of that tendency was employed.

When such an index is employed, we find that the ratio of T-units to sentences does actually decline with maturity, though the other four indexes increase. For fourth graders this index score is 1.60; for eighth graders 1.37; twelfth 1.17. No twelfth grader had a score above 1.50, but one eighth grader, the one who wrote longer sentences than any twelfth grader, had a score of 2.15, and the one fourth grader who also wrote sentences longer than any twelfth grader had a score of 2.95, though his T-unit length was below the average even for the fourth grade.

With the introduction of this index it is possible to put one's finger exactly on the spot that keeps sentence length from being as

valid an index of syntactic maturity for young children as T-unit length. Sentence length is as good an index as it is because it does respond to the natural increase in clause length and in number of clauses per T-unit, and hence in T-unit length. But it is no better than it is because it also responds to the natural decline in number of T-units per sentence. T-unit length is a better index because it does not respond to that index.

Though the differences between the ratio of T-units to sentences for one grade and the next, four years later, is large enough to be significant for grade at the .01 level by an analysis of variance, the chi square test indicates that it is nonsignificant as an index even of immaturity for grades 4, 8 and 12.

These five indexes may be brought together as a synopsis of factors that relate clause length to sentence length. They may be arranged in a row as a sequence of five ratios such that words per clause multiplied by clauses per T-unit equal words per T-unit, and that quotient multiplied by T-units per sentence equals words per sentence. Since length is always measured as words per something, the five indexes may also be thought of as three lengths joined by two ratios.

As a sequence, they represent a refinement upon previous measures used in syntactic development studies. They are applicable to the study of both groups and individuals. With them it is possible to know more about an individual's writing development than could be known from the conventional measures with which CRP 1998 began. For instance, with these five figures we can see that the fourth grader who wrote sentences longer than any twelfth grader, did so not because he was genuinely precocious (that is, high on the most

valid indices of syntactic maturity), but instead because he was high on an index which suggests immaturity. These five indexes provide us with a more sensitive instrument for analysis and diagnosis along five different syntactic dimensions.

When these five figures are obtained for successively older grades, the figures then provide a record of development from grade to grade. A sketch of such development will be provided later in Table 1.

The Synopsis of Clause-to-Sentence Length Factors is a contribution which has been made since the completion of CRP 1998 and so is a contribution made by this study, CRP 5-0313.

1-8. The selection of writings by skilled adults

In order to get some idea of whether the syntactic development of average twelfth graders is near the peak achievable by adults who write especially well, a group of writings published in Harpers and Atlantic magazines has also been studied. If most writing teachers were asked what kind of writing they would choose as a target for students in their composition courses, probably they would name these two magazines as often as any. So these writings are something like targets for schoolchildren.

Articles rather than stories were chosen, for fiction has its own methods. A master, or even a skilled professional, may use special devices peculiar to the art of fiction, and these devices may be separate from those used for exposition.

To say that fiction was excluded does not mean that narration was excluded, of course, for skilled adults use narration for expository purposes even as children do.

The articles were all taken from the first three issues in 1964. The first thousand words were selected unless they seemed clearly atypical of the article as a whole.[1]

Obviously these skilled adults are not just twelfth graders of average IQ grown older. The skilled adults may very well possess highly superior IQ's and a special flair for writing. So providing data on them in addition to the data on three groups of average schoolchildren does not provide us with a continuum in which age is the only variable. But it does provide a continuum of language development, even if average twelfth graders never become skilled adults. The addition of the fourth group shows the direction the younger children would have to take and how far they would have to travel if they ever were to write like skilled adults.

So in Table 1, two summary points are provided: one after the twelfth grade, and one after the skilled adults.

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[1]The articles from Atlantic were: Jan., 1964: A. H. Raskin, "The Power of James R. Hoffa" p. 39 ff.; Wallace Stegner, "Born a Square--The Westerner's Dilemma" p. 46 ff.; Roderick Haig-Brown, "The Death of the Salmon" p. 57 ff.; Gerald Johnson, "The Art of Being Free" p.60 ff.; Carl E. Taylor, "Medical Care for Developing Countries" p. 75 ff. Feb., 1964: S. E. Morison, "A Eulogy" - for Kennedy p. 47 ff.; Archibald MacLeish, "The Gift Outright" p. 50 ff.; Vince Packard, "The Invasion of Privacy" p. 55 ff.; Martha Gelhorn, "Is There a New Germany?" p. 69 ff.

From Harpers: Jan., 1964: Allan C. Barnes, "Reducing the Hazards of Birth" p. 31 ff.; David Boroff, "Fort Hood: Sparta Goes Suburban" p. 46 ff.; Paul Goodman, "Columbia's Unorthodox Seminars" p. 72 ff. Feb., 1964: Thomas S. Szasz, M.D., "What Psychiatry Can and Cannot Do" p. 50 ff.; Edgar Wind, "The Long Battle Between Art and the Machine" p. 65 ff.; Norman MacKenzie, "Harold Wilson's Britain" p. 73 ff.; Herbert J. Muller, "Second Thoughts on the Religious Revival" p. 82 ff.; Polly Redford, "Small Rebellion in Miami" p. 96 ff. March, 1964: Julius Duscha, "Arms and the Big Money Men" p. 39 ff.

1-9. The five synopsis scores for skilled adults plus the writings in CRP 1998

The Synopsis of Clause-to-Sentence Length Factors for schoolchildren of average IQ in grades 4, 8, 12 together with those factors for skilled adults appears in Table 1. The contingency coefficients are given first for those three grades and then for all four groups. In each column the percentages are figured taking twelfth grade performance as 100%.

On the basis of these findings the following conclusions can be drawn:

1. For the study of the writing of schoolchildren of average IQ from grades 4 to 12, the most valid index of syntactic maturity, judging from the contingency coefficient scores, is T-unit length. Second in validity is clause length. Third is the subordinate clause index. Fourth is sentence length. The main clause coordination index is not significant.

2. However, as measures of the full range of development in writing from its beginning in the fourth grade to something like its full culmination in the work of skilled adults, T-unit length and clause length are equally valid. The other indexes keep the same relative validity that they possess over the public school grade range.

3. With the exception of the main clause coordination index, the other four indexes each show an increase over both the four year grade spans and also from twelfth grade achievement to that of skilled adults.

The main clause coordination index declines considerably from grades 4 to 8 and 8 to 12, and then shows a trifling and probably not significant increase in the hands of skilled adults.

TABLE 1 - SYNOPSIS OF CLAUSE-TO-SENTENCE LENGTH FACTORS

	Clause length (words/ clauses)	Subordinate clause index (clauses/ T-units)	T-unit length (words/ T-units)	Main clause coordination index (T-units/ sentences	Sentence length (words/ sentences)
Grade 4	6.6 words 77%	1.30 77%	8.6 words 60%	1.60 137%	13.5 words 80%
Grade 8	8.1 words 94%	1.42 85%	11.5 words 80%	1.37 117%	15.9 words 94%
Grade 12	8.6 words 100%	1.68 100%	14.4 words 100%	1.17 100%	16.9 words 100%
Statistical significance for 3 grades and both sexes by analysis of variance, 2 X 3 factorial	for grade at .01 level, and for sex at .01 level	for grade at .01 level, and for interaction of sex and grade at .05 level	for grade at .01 level	for grade at .01 level, for interaction of sex and grade at .05 level	for sex at .05 level and for grade at .05 level
Contingency coefficient for 3 grades	.616	.496	.694	N.S.	.489
Skilled adults	11.5 words 136%	1.78 106%	20.3 words 140%	1.23 105%	24.7 words 147%
Contingency coefficient for 4 groups	.73	.51	.73	N.S.	.64

4. The most significant single difference between average twelfth graders and skilled adults is in the greatly increased clause length. That increase by itself is sufficient to account for about 80% of the actual difference between the two groups in T-unit length and about 70% of the actual difference in sentence length.

1-10. The intercorrelation of the five synopsis scores

A study of the intercorrelation of the five synopsis scores for each individual within each grade or group gives us a little new information not already evident from the synopsis scores. The correlations also provide confirmation of impressions derived from a study of the synopsis scores themselves.

In Table 2 appear the intercorrelations of these scores for each of the three grades (labeled G 4, G 8, G 12) plus skilled adults (labeled SA) plus the intercorrelation for all 54 schoolchildren in 3 grades (labeled All G) and for all 72 writers (labeled All).

From Table 2 these conclusions can be drawn:

1. As has been explained already, T-unit length is a good index of maturity, and a writer may score high on it either because he scores high on clause length or on the subordinate clause index. As the maturity level changes, T-unit length changes steadily in its relation to those two contributing factors. For instance, at G 4 T-unit length correlates very highly to the subordinate clause index, but not significantly to clause length. However, at G 8 it is related to both, though still more highly to the subordinate clause index. At the next stage, G 12, it is still related to both, but by now more highly to the other index, clause length. Taking all the individuals in the three grades together, or in all four groups together, T-unit length is very highly correlated to both contributing factors.

TABLE 2 - INTERCORRELATION OF THE FIVE SYNOPSIS SCOPES

	Subordinate clause index	T-unit length	Main clause coordination index	Sentence length
Clause length	All G .436 All .527	G 8 .544 G 12 .831 All G .836 SA .549 All .907	All G -.301 All -.305	G 12 .540 All G .4288 All .715
Subordinate clause index		G 4 .850 G 8 .683- G 12 .538 All G .831 SA .655 All .819	All G -.315 All -.320	G 8 .578 G 12 .579 All G .4267 SA .685 All .663
T-unit length			All G -.381 All -.340	G 8 .560 G 12 .722 All G .483 SA .796 All .793
Main clause coordination index				G 4 .961 G 8 .875 G 12 .589 All G .591 All .272

The situation at G 4 seems to be this: Fourth graders at best lengthen their clauses so very little beyond the minimum allowed by the language that any individual differences in this respect are completely overshadowed by the differences in the number of these clauses per T-unit. The fourth grader with the highest score on clause length scored only 21% more than the one with the lowest score, but the fourth grader with the highest score on the subordinate clause index scored 55% more than the one with the lowest score. Clearly, one varies more widely than the other.

2. The two factors contributing to T-unit length are not correlated with each other significantly at any single level of maturity. That is, at any one maturity level those who write the longest clauses may or may not be the ones who write the largest proportion of subordinate clauses.

However, if we take the 54 subjects or 72 subjects simply as individual human beings, disregarding their maturity level, we find a significant tendency for those who write the longest clauses also to write the largest proportion of subordinate clauses. After all, those who do the one tend to be older, and those who do the other tend also to be older. Both indexes were already known to signify maturity.

3. It has already been remarked that the main clause coordination index is not a significant index of maturity. That fact is manifested here by its failure to correlate significantly at any maturity level with any of the indexes of maturity except sentence length, the least valid, and the one whose validity it helps to weaken by its contribution.

The fact that the main clause coordination index does correlate significantly, and negatively, with the valid maturity indexes when we take the 54 or 72 individuals together is merely a manifestation of the fact, already remarked, that it tends to decrease with maturity.

4. The highest correlation in Table 2 is an almost perfect one, .961. That correlation is between sentence length and the main clause coordination index at the fourth grade level. This fact merely corroborates the observation, made several times already, that for young students sentence length is highly affected by their tendency to string out their sentences with or without and's.

The correlation between these two indexes declines steadily as the maturity level increases (.961, .875, .589) until, for skilled adults, it is not significant at all. This progression indicates that main clause coordination affects sentence length less and less at more mature levels; thus sentence length improves as an index of maturity for older writers. Whether among adults sentence length will separate average from superior writers as well as T-unit length does is not yet known.

Since sentence length at higher maturity levels is affected less by main clause coordination, it is of course affected more by T-unit length. This is inevitable because of the arithmetical relationship. The intercorrelations given in the table merely corroborate this effect.

1-11. Corrections on opinions held a decade ago

We now possess enough information covering a span of years from grade 4 to maturity to correct and modernize the summary of syntactic

development studies as set forth by Dorothea McCarthy a decade ago, and as summarized in section 1-5.

CRP 1998 refuted each of these points, or at least provided substantial statistical evidence for revising each one. The introduction of the Synopsis of Clause-to-Sentence Length Factors provides further evidence.

In opposition to the points listed in section 1-5 the following conclusions are drawn on the basis of findings in CRP 1998 and those presented here.

1. The five measures presented in the Synopsis are all objective and reliable, though they do require some grammatical competence on the part of the analyst. To mark the boundary of a sentence is, indeed easier and perhaps faster, for it requires no grammatical competence whatsoever--only the ability to recognize capital letters and terminal punctuation marks when they stand as markers between sentences.

However, the relative validity of the various measures is another matter. To distinguish between the writings of average fourth graders, eighth graders and twelfth graders, sentence length is a less valid index than three other indexes used in the Synopsis and referred to in the paragraphs immediately below.

Shifting our attention momentarily from chronological maturity to mental maturity, we will discover later on that fourth graders of superior IQ write <u>shorter</u> sentences than fourth graders of average IQ.

2. It is not true that clause length remains fairly constant from grades 4 to 12. For students of average IQ, clause length increases by about one fourth over that time span.

To believe that the nature of language sets low limits to the length of clauses is indeed erroneous, for skilled adults write clauses about 70% longer than those written by fourth graders of either average or superior IQ.

Indeed it is precisely in clause length that the later and fuller development of the language does occur. It will be shown that what distinguishes superior twelfth graders from their average classmates is their greater clause length. In fact, the particular group of superior twelfth graders studied here write <u>fewer</u> subordinate clauses and <u>shorter</u> sentences.

What distinguishes skilled adults from the average high school graduate is again their greatly lengthened clauses more than their slightly increased number of subordinate clauses.

It is not, then, the length of cluases that the nature of language sets a ceiling on, but instead the number of subordinate clauses. The ceiling for subordinate clauses, is, of course, a rubber ceiling, but it is approached or reached by most students relatively early in their school career--at least by the twelfth grade. To develop beyond the level of the average twelfth grader, it is the other skill that must be learned, the skill of consolidating structures into longer and longer clauses.

3. The notion that syntactic development throughout the school years consists largely of an increasing ability to write more subordinate clauses is not completely erroneous, but it is certainly in need of refinement.

As was mentioned in the previous section, in the later grades and in maturity it is certainly not the number of subordinate clauses that distinguishes greater chronological or mental age. However, in

the early grades, or, more precisely, in the fourth grade, we will see that it is just this factor which does most clearly distinguish the superior IQ from the average IQ.

CHAPTER 2. PROCEDURE ON THE WRITINGS BY SUPERIOR SCHOOLCHILDREN

2-1. The meaning of "average student" and "superior student" in this study

The students called "average" in this study are simply those who scored between 90 and 110 on the Short Form of the California Mental Maturity Test administered during the year they were doing the writing. The over-all quality of their writing might have been judged above or below the average by skilled judges, but such judgment was not sought. When they are called "average fourth graders" the expression is intended to mean nothing other than "fourth graders with average IQ scores."

The students called "superior" are simply those who scored 130 or above on the Short Form of the California Mental Maturity Test. Actually such scores are "highly superior." The over-all quality of their writing was not judged.

On 31 of the 36 fourth graders who appeared in the average and superior groups, Wechsler-Bellevue scores were also obtained. The correlation between the various sub-scores on that test and certain syntactic measurements are reported in section 3-2. However, the original selection of groups was made on the basis of the California scores, not the Wechsler-Bellevue.

2-2. Selection of students

All students used in this study were from the Tallahassee, Florida, schools. The fourth graders, both average and superior, were from the

University School of Florida State University. The twelfth graders came from two schools. The average twelfth graders came from the University School, but to find a large enough enrollment to produce the requisite number of boys and girls with IQ scores above 130, it was necessary to go to the larger public high school, Leon High. From among the students above the cut-off score those with the highest scores were used.

In each average group, and again in each superior group, there were nine boys and nine girls. Thus a total of 36 fourth graders and an equal number of twelfth graders were chosen.

The ages of the average fourth graders as contrasted with the superior fourth graders showed nothing approaching a significant difference by the Wilcoxon rank sum test. The same was true of the average and superior twelfth graders.

2-3. The specifications for the writings

Once the students were chosen on the basis of test scores, their teachers were asked "During this term, have each student write more than a thousand words in the classroom under your supervision without any changes being made by anyone after the writer finishes. Let his subject matter be whatever he is writing on in his regular class work. When he has completed more than a thousand words in this way, turn in his writings to the investigators." Thus the subject matter was controlled by the teachers and students, not the investigators.

2-4. The exclusion of certain kinds of sentences

In CRP 1998 the whole writing sample was studied, except for the unintelligible passages, false starts, etc., which the younger

children sometimes failed to delete before they handed in their papers.

From the materials to be described hereafter certain kinds of sentences have been excluded. Those excluded were either questions, answers, imperatives, sentence fragments or, more important, those that contained direct quotations or direct discourse.

Sentences containing direct discourse were excluded mainly because it was felt, for reasons given below, that samples without them would be slightly better for measuring syntactic capability than samples with them. How often a writer uses direct discourse depends on whether or not he happens to be writing about what people said. The fourth graders in CRP 1998 used direct discourse very freely--about .6 times as often as the twelfth graders did. But there is no reason to suppose that the twelfth graders had lost the ability to do so--they simply were writing different kinds of themes. Yet the frequency of direct discourse has a definite effect on certain syntactic measures. For one thing, such sentences often contain brief expressions like "Jim said," and these tend to shorten the clause length average slightly each time they occur. Furthermore, since each piece of direct discourse must be counted as a dependent noun clause, the frequent occurrence of direct discourse tends to give the fourth graders credit for many noun clauses. Direct discourse accounted for 36% of all the noun clauses for the fourth graders in CRP 1998, but only 5% of the noun clauses for twelfth graders. For these reasons it seems clear that the presence of sentences containing direct discourse will affect the results in certain ways which have nothing to do with the syntactic competence of the writers.

Another quite different reason for excluding direct discourse sentences is that if ever syntactic "norms" are to be used to study the differences between fiction and various types of nonfiction it will be desirable to study separately those sentences with dialog and those without. In one set the author speaks, in the other someone else speaks.

The reasons for excluding the others, imperatives, questions, answers, and sentence fragments are of a different order. In fact, they are excluded more to make the syntactic analyst comfortable than because they affect his results appreciably. While in speech questions, answers, imperatives and sentence fragments are very common, in writing they are too infrequent to affect the results in the least. Furthermore, once the analyst separates out direct discourse he will also have separated out many of the questions, answers, imperatives and fragments.

Their presence may make the analyst uncomfortable, however, especially if he has a puristic or defensive disposition. Imperatives have you and the volitional will deleted but understood, and thus they have no visible subject and finite verb to qualify them as clauses under a literal interpretation of the definition given in this study. Answers to questions are truly less than clauses, very often, being usually the semantic and syntactic fillers for the spaces occupied by the interrogatives in the question which elicits them. Whether questions also are excluded is really of no consequence to the results, but they will be excluded hereafter, along with answers, partly because when they and sentence fragments are excluded the description of the sentences remaining in the sample becomes very

simple. What remain are just the declarative sentences that do not contain direct discourse. That is an easy description.

However, it is true that a series of rhetorical questions do present for analysis special problems which appear much less frequently in declarative sentences. Witness how the first clause is understood in the subsequent rhetorical questions which begin one of the articles by one of the skilled adults.

> Do all Pacific salmon die after spawning? Yes. Even the pink salmon, after a life of less than two years? Even the great and powerful king salmon? Even the jacks, the precocious males that come back after only one short year in the sea? Yes, they all die.

It seems likely that a writer's syntactic accomplishment would be more adequately represented by just his declarative sentences without direct discourse, and that more will be gained than lost by separating out the others.

2-5. Does the exclusion of certain sentences affect the synopsis scores?

Anyone can fancy a piece of writing which included direct discourse which happened to be radically different in syntactic structure from the sentences without direct discourse. For such a piece of writing, it would make a difference whether one analyzed all sentences, as was done in CRP 1998, or whether he excluded certain kinds as will be done hereafter in this study.

But for the writing of schoolchildren does such exclusion make a difference in the synopsis scores? The answer in general seems to be "Yes, it makes a slight difference, but the difference is not large enough to be statistically significant--the difference is no larger than chance is playing in the research anyway." At

least that answer is appropriate for the 18,000 words of fourth grade writing and 18,000 words of twelfth grade writing that were tested both ways.

About 8.5% of the words of the average fourth graders appeared in the kind of sentences now to be excluded. Once sentences containing direct discourse were excluded, virtually all the other kinds to be excluded were automatically taken care of, and they were extremely infrequent anyhow. But separating out this 8.5% had a slight effect on the five synopsis scores, as will be seen in a moment.

Average twelfth graders, in contrast to fourth graders, wrote only 1.4% of their words in the sentences to be excluded, so the separation had no effect at all on the results except that the last digit might now be rounded off to the next higher or lower figure. The differences are not worth mentioning.

The effect on the five synopsis figures for fourth graders is interesting, however, though it should be noted in advance that none of the differences was sufficiently large to show statistical significance by the Wilcoxon rank sum test. The clause length of the excluded sentences was shorter, so the mean clause length was increased from 6.6 to 6.8, a change of 3%. Some of the excluded sentences were as short as this: "Jim said, 'Yes.'" Here are two clauses totalling three words, with a mean clause length of one and a half words: the investigators were more comfortable to be rid of such extremities. The subordinate clause index declined insignificantly from 1.30 to 1.26. T-unit length remained unchanged. The main clause coordination index decreased nonsignificantly from 1.60 to 1.49. Sentence length decreased insignificantly from 13.5 to 13.2.

However, though the subordinate clause index as a whole survived with no significant change, the exclusion of direct discourse brought a substantial reduction in the number of noun clauses: a decrease from .137 per T-unit to .089, about one third.

The frequency of the other kinds showed no significant change: adjective clauses shifted from .045 to .047 per T-unit; adverb clauses from .104 to .101.

So it can be said for the sake of future research that it seems to make no significant difference in the five synopsis figures whether all sentences are analyzed or only declarative sentences without direct discourse. However, it does make a substantial difference in the number of noun clauses. This investigator recommends for the future that the separation of sentences be continued. As syntactic research refines its tools there may come a time when the separation is clearly advantageous.

In the following chapters the average writings for grades 4 and 12 are those used in CRP 1998 except that certain sentences are now excluded from the corpus. The same kinds of sentences have been removed from the all other writings now to be discussed.

2-6. Passing references to two short stories

Though the analysis of short stories was not a major part of the study, the investigator was curious to see whether the syntactic characteristics of the nondialog sentences of mature fiction were notably different from those of nonfiction. As an example of fairly normal narrative prose, Hemingway's The Short Happy Life of Frances Macomber was chosen. As an example of more elaborated prose, Faulkner's Barn-Burning was chosen.

Certain syntactic characteristics of the nondialog sentences in those stories will be mentioned in passing in the chapter on the synopsis scores for skilled adults and in the discussion of the various kinds of subordinate clauses.

CHAPTER 3. THE FIVE SYNOPSIS SCORES FOR AVERAGE AND SUPERIOR FOURTH GRADERS

3-1. The significant differences in synopsis scores

In this section an answer is sought to this question: Are those syntactic measures which are significant indicators of chronological maturity in the school grades also significant indicators of mental maturity within the same early grades, at least within the fourth grade?

The synopsis scores for the two groups appear in Table 3 and after the table is a discussion of the significant findings. To determine significance the Wilcoxon rank sum test was used. Underneath the scores are the percentages of twelfth grade performance.

The conclusions to be drawn from Table 3 are these:

1. It should be borne in mind that for the eight year span from grades 4 to 12, T-unit length is the most valid index of maturity. Here we see that it is also a significant index for separating students of average and superior IQ in the fourth grade. The level of significance is .05, and the index increases with mental maturity.

2. The subordinate clause index (found previously to be one of the significant measures of chronological maturity for average students from grades 4 to 12) is also a significant index for separating students of average and superior IQ in the fourth grade. The level of significance is .005, and the index increases with mental maturity.

TABLE 3 - DIFFERENCES BETWEEN AVERAGE AND SUPERIOR FOURTH GRADERS ON SYNOPSIS SCORES

	Clause length (words/ clauses)	Subordinate clause index (clauses/ T-units)	T-unit length (words/ T-units)	Main clause coordination index (T-units/ sentences)	Sentence length (words/ sentences)
G 4 Ave. IQ	6.8 43%	1.26 73%	8.5 43%	1.49 120%	13.2 53%
Level of significance of difference	N.S.	.005	.05	.01	
G 4 Sup. IQ	6.8 43%	1.35 80%	9.3 47%	1.18 101%	10.9 48%

This finding needs to be related to the previous and the following findings if it is to be properly understood.

3. Clause length (found previously to be a significant measure of chronological maturity for average students from grades 4 to 12) is NOT a significant index for separating students of average and superior IQ in the fourth grade.

This finding and the previous two are in perfect accord with the observation which was made on the basis of the intercorrelation of scores by average fourth graders alone in section 1-10:

> The situation at G 4 seems to be this: Fourth graders at best lengthen their clauses so very little beyond the minimum allowed by the language that any individual differences in this respect are completely overshadowed by the differences in the number of these clauses per T-unit.

4. Table 3 shows that the sentences written by superior fourth graders are actually shorter than those written by average fourth graders. This finding provides one more puncture to the myth already deflated in CRP 1998 that sentence length is anything more than the crudest of measures of maturity in the early grades.

5. The fact that sentence length (words/sentences) is the arithmetical product of T-unit length (words/T-unit) multiplied by the main clause coordination index (T-units/sentences) is useful as an explanation of sentence length.

Although the T-unit length for superior students is larger, as was noted in item 1 above, their main clause coordination index is smaller. One tendency opposes the other, and one substantially exceeds the other. Consequently, while T-unit length goes up with mental superiority, the other tendency pulls down hard enough that sentence length likewise goes down with superiority.

This interaction of the three indexes at the fourth grade level for the two groups is similar to the phenomenon that was observed in CRP 1998 as occurring across a eight year span for average students. A few average fourth graders lengthen their sentences prodigiously by writing and after and after and where mature writers would put periods. Superior fourth graders write shorter sentences because they have learned more quickly when to put periods.

3-2. Correlation of synopsis scores with Wechsler-Bellevue subscores

Though Wechsler-Bellevue scores were not available for all the 36 fourth graders in the superior and average groups, they were available for 31 of them.

For those 31 individuals, an intercorrelation matrix of the syntactic scores and the various WB IQ subscores will not tell us much that is new about the interrelations of the syntactic scores themselves, but it will give us an idea of what mental capacities are related to syntactic maturity. Those relationships are presented in Table 4 and discussed hereafter.

Intercorrelations which were not significant for at least the .05 level are omitted.

1. Looking first at the various syntactic measures, we see what we would expect from the first two findings of the previous section, that is, that subordinate clause index and T-unit length are the measures most frequently and highly related to IQ scores. (Sentence length bears no significant relation with any IQ score.)

2. Relating the syntactic scores to the various IQ scores, we observe several things.

TABLE 4 - CORRELATION OF SYNOPSIS SCORES AND INTELLIGENCE TEST SCORES

Wechsler-Bellevue test scores	Clause length (words/ clauses)	Subordinate clause index (clauses/ T-units)	T-unit length (words/ T-units	Main clause coordination index (T-units/ sentences)	Sentence length (words/ sentences)
Verbal					
I		.3978			
C		.4275	.4350		
S	.3990		.4844	-.4188	
V		.5023	.4920		
Performance					
PC	-.3944	.3901			
PA					
BD					
C		.3779	.3610		
Verbal IQ		.4875	.5000		
Perform IQ		.4259			
Full Scale IQ		.5769	.4356	-.3650	
California Short Form		.4327	.3944		

a. It is no surprise if the syntactic scores correlate a little more highly with the elaborate WB total scores than with the simpler and briefer CSF.

b. Among the WB subscores, the syntactic indexes correlate more highly and more frequently with the various verbal than with the various performance subscores. They also correlate more highly with the total verbal (.4875) as contrasted with the total performance (.4259). However, it is also interesting that the total WB score correlates with the syntactic measures more highly than does the total verbal without the performance.

c. Among the several verbal subscores the highest correlation (.5023) is with the V score, a score of vocabulary recognition. Next highest (.4275) is the C score, a measure of verbal reasoning. Next is the I score (.3978), a measure of the child's fund of information and one related to the amount of reading he has done. The remaining subscore seems interesting. It relates to abstract reasoning, the recognition of similarities. It correlates nonsignificantly (.2893) with column 2, but significantly (.3990) with column 1, clause length. The effect of these two relations is a correlation of .4844 for T-unit length, a correlation almost as high as we get for any score except the full scale IQ score. This subscore is the only one which correlates positively and significantly with clause length, the syntactic trait which will be developed to great lengths by the skilled adult.

d. Certain of these syntactic indexes correlate with intelligence about as highly as reading test scores usually do.

3-3. Summary

1. To separate students of superior IQ and of average IQ in grade 4, T-unit length is a valid index but the subordinate clause index is better. Both indexes increase with mental maturity (as they do with chronological maturity). Clause length is not significantly different for average and superior students in the fourth grade.

2. Superior fourth graders write <u>shorter</u> sentences than average fourth graders, even though they write longer T-units. The obvious

explanation is that they have learned better how to punctuate, and consequently they write significantly fewer T-units per sentence.

3. In the fourth grade, syntactic maturity is related to the verbal factors on the Wechsler-Bellevue much more highly than to the performance factors. Among the various verbal subscores, the one on abstract reasoning correlates especially highly with syntactic maturity.

CHAPTER 4. THE FIVE SYNOPSIS SCORES FOR AVERAGE AND SUPERIOR TWELFTH GRADERS AND FOR SKILLED ADULTS

4-1. The five synopsis factors for three groups

In this section three groups are to be studied, first, 9 boys and 9 girls in the twelfth grade with IQ scores between 90 and 100, called average; second, a similar number of boys and girls at the same grade level and comparable ages with IQ scores above 130, called superior; third, 9 writers for Harpers and 9 for Atlantic called "skilled adults." A thousand word sample has been taken from each writer's work, and that sample includes only those declarative sentences which contain no direct quotations or direct discourse.

Answers to such questions as the following will be sought:

1. Are the synopsis scores sufficiently sensitive to detect a difference in syntactic maturity between twelfth graders of superior and average IQ?

2. Which indexes show that difference?

3. How does the difference between the two groups of students at the end of the public school years compare with the difference which occurs over the eight year span from grades 4 to 12?

4. Have average twelfth graders reached the peak of syntactic development allowed by the language as measured here, or do more intelligent students and skilled adults carry the developmental tendencies still farther?

The figures for the five synopsis scores for the three groups appear in Table 5 below. Between the rows are other figures indicating whether the differences are statistically significant and at what level by the Wilcoxon rank sum test.

The percentage figures beneath the five indexes for each group are computed taking the performance of average twelfth graders as 100%. The percentages indicate how far the two other groups have advanced, or declined, from average twelfth grade performance.

The following conclusions may be drawn from Table 5.

1. For students at the end of high school, T-unit length is still a significant index of mental maturity. Superior twelfth graders are about 12% ahead of average students in the same grade, and that difference is significant at the .05 level. But skilled adults are more than three times as far ahead (40%), and the difference is significant at the .005 level. Superior twelfth graders lie a third of the way between their average classmates and skilled adults.

However, for a fuller understanding, it is important to break down the differences in T-unit length into the two component scores as is done in the next two sections.

2. The most significant index of superiority at this upper level is apparently clause length. Superior twelfth graders are about 21% ahead (the significance is at the .01 level). Superior twelfth graders lie more than half way above their average classmates toward skilled adults.

3. In subordinate clause index (the ratio of clauses to T-units) there is no significant difference between skilled adults and average twelfth graders. This fact supports the impression that, though learning to write more subordinate clauses is a significant measure of maturity throughout most of the school years (grades 4 to 12), there is a practical limit to this tendency and that average twelfth graders have about reached it. Beyond their level of achievement increased skill and maturity manifests itself in another direction: in increased clause length.

The fact that the superior twelfth graders here measured write actually fewer subordinate clauses than their average classmates strongly supports the impression that once a student's index has approached 1.5 or 1.6 his further development will not be measured by this index, or at least not by this index alone.

There may, of course, be another principle operating here, which this study does not investigate: that is, that T-unit length is still the best rough index of maturity even at this level, an index of how much information writers can organize at once--how much syntax they can straighten out at once--and that as they surge ahead in clause length they back down on the number of subordinate clauses.

A completely different hypothesis, of course, is that the relatively small number of subordinate clauses is simply a characteristic of the different subjects that the average students and the superior ones happened to be assigned. Only further research can afford an explanation.

TABLE 5 - DIFFERENCES IN SYNOPSIS SCORES BETWEEN THREE OLDER GROUPS

	Clause length (words/ clauses)	Subordinate clause index (clauses/ T-units)	T-unit length (words/ T-units)	Main clause coordination index (T-units/ sentences)	Sentence length (words/ sentences)
Grade 12 (Average IQ)	8.6 100%	1.68 100%	1.45 100%	1.17 100%	16.9 100%
Statistical significance of differences	.005	.025	.05	N.S.	N.S.
Grade 12 (Superior IQ)	10.4 121%	1.54 91%	1.62 112%	1.15 98%	1.86 110%
Statistical significance of differences	.005 .025	N.S. .005	.005 .005	N.S. N.S.	.005 .005
Skilled adults	11.8 137%	1.74 104%	20.3 140%	1.25 107%	25.2 149%

4. Though by this time there should be no need to beat the dead horse of sentence length any more, it is interesting that there is no significant difference in the main clause coordination index (ratio of T-units to sentences) between skilled adults and average twelfth graders, or between average and superior twelfth graders. The significance of this fact is simply that whatever validity there may be in sentence length as an index of maturity in the upper grades will still more clearly be indicated by T-unit length, which is affected by factors known to have some significance of maturity, and not by this factor known not to.

4-2. Summary

The five indexes related arithmetically to one another in the Synopsis of Clause-to-Sentence Length Factors provide an improved instrument for the quantitive study of language development. T-unit length is a significant measure of both chronological and mental maturity in writing at least during the public school years. It is a more valid measure than sentence length and should replace it in all serious studies covering that developmental range.

However, T-unit length appears not to be the best single index at the extreme ends of the developmental continuum. In the early grades the subordinate clause index is a better index of mental maturity. In the later grades and for adults, clause length appears to be the most valid index. Even so, T-unit length is useful because it allows an appraisal of the relative influence of the other two factors.

At this stage one gets the impression that as human beings develop they attempt to learn, and do learn, to organize larger and larger bodies of syntax--of information--into their syntactic units. Furthermore, number of words per T-unit is at least a rough measure of the size of this body of information--of syntax. It is not supposed that older students add more words, but that instead they combine their words and structures into larger units.

In the early grades this combinatory impulse is manifested mainly by an increase in the number of clauses subordinated to main clauses, and only slightly by an increase in clause length.

During the middle grades, increases occur in both respects.

By the later grades the law of diminishing returns has set in for the subordinate clause index, but not for clause length. Clause length for twelfth graders of superior IQ is distinctly greater than it is for their average classmates. And skilled adults are still farther ahead of average twelfth graders.

CHAPTER 5. WHICH KINDS OF SUBORDINATE CLAUSES INCREASE WITH MATURITY?

5-1. The increase of subordinate clauses in general

It is well established by now that older students write more subordinate clauses. That tendency was established in CRP 1998 and by many earlier studies, and the previous sections of this study have repeated those results.

Older students tend to write more of them whether their frequency is measured by the number occurring in some given number of words, perhaps a thousand, or by the number per T-unit. To compare the frequency for a given number of words one needs only look at the total number of occurrences recorded in this section, for each group wrote within 1% of 18,000 words (except the average fourth graders: their sample is about 8% shorter so the total number of occurrences would need to be increased by that amount to be strictly comparable). We are also interested in the relative frequency of subordinate clauses to main clauses, and for that purpose the number per T-unit is the most convenient measure. That measure tells us the likelihood that a T-unit will contain the item in question.

5-2. Do all kinds of subordinate clauses increase equally?

The reason to study separately the increases in the different kinds of subordinate clauses is to see whether one or another kind seems to increase steadily with maturity whereas some different kind fluctuates in such a way as to seem independent of maturity.

If some kind fluctuates independently of maturity, an inviting explanation might be that it is fluctuating in response to some other variable such as subject matter. No systematic investigation of this relationship was undertaken here, though some subjective impressions will be reported later.

5-3. Clauses and their kinds

If a reader is to understand this report, or if another researcher is to replicate or extend these findings, it will be necessary that a few remarks be made about the basis for classifying certain kinds of clauses into one category or the other. On the whole, the traditional classification has been followed, but on certain minor matters there are several traditions rather than one.

In schoolroom grammar a clause is defined as a structure containing a subject (or coordinated subjects) and a finite verb (or coordinated finite verbs). That definition will suffice here. Thus, "I went home" is counted as one clause, and so is "Jim and I went home and climbed up to our treehouse." "We expected that he would come" is counted as containing two clauses, but, "We expected him to come" is counted as containing one.

The usual distinction between a main clause and a subordinate or dependent clause will suffice here, though some cautionary remarks will follow in the next section.

In general the usual distinctions between noun, adjective and adverb clauses will suffice here also, but certain relatively infrequent patterns will be tabulated by themselves. For instance, clauses of comparison (He played longer than I did) are tabulated by themselves rather than with the commoner type of adverb clause which is movable with respect to its main clause. Similarly, "cleft sentences" (It's the littlest kid that always gets hurt) and "deferred subject sentences" (It's a shame that Jim couldn't come) are tabulated by themselves, as was done in CRP 1998.

Regarding classification into even the three major categories of subordinate clauses, certain cautionary remarks need to be made.

5-4. Movable adverb clauses and immovable coordinated clauses

As was remarked in CRP 1998 (pp. 54-6), it is not always possible to distinguish between main clauses and certain subordinate clauses by relying on the notion that subordinate clauses are of subordinate importance but main clauses are of first-order importance. Fortunately, however, other criteria are available.

The fourth grader who wrote "Mother came home and I got spanked," employing two coordinate clauses, might also have written "When Mother came home I got spanked," subordinating one clause. The subordinated clause with its introducer when is movable with respect to the other clause. Thus we can say "I got spanked when Mother came home."

Such subordinate clauses are called movable adverbial clauses in the study, and, for the sake of simplicity, only they are counted as adverb clauses. In the other sentence, the coordinated clause with its introducer and cannot be moved with respect to the other clause. It is not grammatically allowable to write "And I got spanked Mother came home." Coordinators like and relate their structures only leftward, whereas subordinators like when and if relate their structures either leftward or rightward: that is another way of saying that they are movable.

It is possible, of course, for two coordinated clauses both to be subordinated. Thus the sentence "When Mother came home and my father heard about it, I got spanked" is counted as having two movable adverbial clauses.

Using the criterion of movability, the coordinator so, which is replaceable with and so, may be distinguished from the subordinator so replaceable with so that.

She ate bread crusts so her hair would curl.
She ate bread crusts so that her hair would curl.
So her hair would curl, she ate bread crusts.
She ate bread crusts, so her hair curled.
She ate bread crusts, and so her hair curled
NOT *So her hair curled, she ate bread crusts.

An isolated sentence may be ambiguous in this regard.

Stephen Daedalus broke his glasses so he could not write out the lesson.

5-5. Noun clauses like "the idea that S"

Fairly common in English are sentences like

1. His idea that the earth was round interested no one.

Clearly "His idea" is related to "that the earth was round" in such a way as to allow the two expressions to stand on opposite sides of the verb BE with one serving as subject and the other as predicate nominal:

2. His idea was that the earth was round.

"Idea" is not the only word that can precede such clauses: others are belief, hypothesis, notion, contention, fact, etc.

It is indeed true that the clause modifies the noun "idea," telling "which idea," but that is not a sufficient reason to classify the clause as noun in this study, for in this study not all single-word modifiers of nouns are classified as adjectives either. Single-word modifiers of nouns, as in "hungry dog" are classified as adjectives only so long as they can be paraphased with predicate adjective sentences,

3. The dog is hungry.

Single-word modifiers of nouns, as in "collie dog," which are paraphrased with predicate nominal sentences are classed as nouns modifying

nouns, not as adjectives.

4. The dog is a collie.

So the "idea that S" is classed as a noun followed by a noun clause, analogous to "collie dog," not a noun followed by an adjective clause, analogous to "hungry dog."

5-6. When and where clauses preceded (or not) by nouns of time and place

Perhaps certain other distinctions made in this study between noun clauses, adjective clauses and adverb clauses need also to be explained. For instance, "when" clauses seem to have a noun of ttime optionally supplyable or deletable before them; "where" clauses seem to have a noun of place optionally supplyable or deletable before them. That is, we have in English

1a. This happened that time when he spoke.
1b. This happened when he spoke.
1c. I remember that time when he spoke.
1d. I remember when he spoke.

In the first pair of sentences, 1a and 1b, the expressions which follow "this happened" are adverbials of time. In the first one of the pair, 1a, the adverbial of time is analyzable further as a noun of time followed by an adjective clause as its modifier. Thus the sentence is analogous to

2. This happened the earlier time.

Here, analogously, "the earlier time" is an adverbial of time analyzable further into a noun (more properly a NP) and an adjective.

In sentence 1a, "when he spoke," being an adjective clause, cannot be moved away from the noun it modifies. It cannot be moved like an adverbial clause and we cannot say, except with a different meaning,

3. *When he spoke, this happened that time.

However, the whole adverbial of time can be moved as a unit, and we do have

4. That time when he spoke, this happened.

Once the optional noun of time is deleted, as in sentence 1b, however, then the "when" clause survives as all there is to the adverbial of time, and then it is movable: we do have

5. When he spoke, this happened.

In the second pair of sentences, 1c and 1d, the expressions which follow "I remember" are not adverbials of time, but instead are nouns (or, more properly, nominals if one follows Lees, or NP's if one follows Chomsky). They function as direct objects of the verb.

In the first sentence of this pair, the nominal is analyzable further as a noun followed by an adjective clause, analogous to

6. I remember the earlier time.

In the second sentence of that pair, with the noun deleted, the clause alone is the nominal functioning as direct object.

To summarize the four cases, then, 1a contains an adjective clause, 1b contains an adverbial clause, 1c contains an adjective clause, and 1d contains a noun clause.

Similar analyses could be given for the following sentences in which a noun of place rather than time is optionally supplyable or deletable.

7a. This happened at the place where he spoke.
7b. This happened where he spoke.
7c. I remember the place where he spoke.
7d. I remember where he spoke.

In 7a the subordinate clause is classified in this study as an adjective clause, in 7b as an adverb clause, in 7c as an adjective clause, and in 7d as a noun clause.[1]

5-7. The frequency of adjective clauses

CRP 1998 found that through grades 4, 8 and 12 the number of adjective clauses doubled for a given number of words. The increase measured by number per T-unit was still more impressive.

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[1]"When" itself designates the grammatical category noun of time, and it is from this category rather than from thin air that the indefinite noun of time is optionally supplyable. However, the noun of time may function as either a noun, (for instance a direct object as in 1c) or as an adverbial (as in 1a), and the word "when" does not tell which it is; only the context tells which it is. Similarly "where" contains the category noun of place. It may seem strange to some readers to speak of these relative adverbs as containing nouns, but usually places and times are expressed by nouns. The subordinate clauses used in the examples above may be derived from the sentences below, in a fashion usual for relatives:

He spoke some time.
He spoke some place.

Notice that, in at least some dialects, relative pronoun "that" may be used instead of the relative adverbs in sentences 1a, 1c, 7a, and 7c so long as the nouns of place or time survive.

This happened the time that he spoke.
I remember the time that he spoke.
This happened at the place that he spoke.
I remember the place that he spoke.

However, "that" designates the category noun in general, without also designating noun of time or noun of place. Therfore, when the noun of time or noun of place is deleted, as from 1b, 1d, 7b, 7d, sentences with "that" instead of when or where would become either ungrammatical and unintelligible or mean something else.

*This happened that he spoke.
I remember that he spoke. (a different sentence)
*This happened that he spoke.
I remember that he spoke. (a different sentence)

The time and place meanings have disappeared.

In fourth grade the number was .045 per T-unit. For eighth grade the number doubled, .090. For twelfth it nearly doubled again: it became .165, more than three and a half times the fourth grade frequency. By analysis of variance, the differences were found to be significant at the .01 level. Neither adverb nor noun clauses showed that high and steady rate of increase.

Anyone who has studied fourth grade writing, or even eighth grade writing, has found an abundance of occasions when the student wrote as two separate main clauses something that more maturely could have been written as an adjective clause embedded within the other clause. Apparently the language provides abundant opportunities for combining in this way, and as writers mature they learn to do so more and more.

When we compare the number of adjective clauses per T-unit written by average and by superior fourth graders (Table 6), we find a very substantial difference: .047 for the average group, and .076 for the superior group. Testing the individual scores by the Wilcoxon rank-sum test we affirm that the difference is significant, and at the .01 level. As early as the fourth grade this is a significant index of mental maturity.

When we look to the three older groups we again find a very substantial increase with maturity, both chronological and mental, superior twelfth graders exceeding average twelfth graders and skilled adults exceeding both the younger groups.

When in Table 6 we read straight across the sequence arranged in order of mental maturity, we find an impressively strong and steady increase. The G 8 score of .09 from CRP 1998 would fall into its predicted place.

TABLE 6 - FREQUENCY OF ADJECTIVE CLAUSES

	Ave. G 4	Sup. G 4		Ave. G 12	Sup. G 12	Skilled adults
Total occurrences	93	151		209	238	232
No. per T-unit	.047	.076		.166	.207	.258
% of ave. G 12	28.6%	46.0%		100%	125%	155%

The percentages of average twelfth grade performance provide a convenient measure of the size of the increases: average G4, .048 (29%); superior G4, .076 (46%); average G 8, .089; average G 12, .166 (100%); superior G 12, .207 (125%); skilled adults,..258 (155%). The likelihood that an average fourth grader will imbed an adjective clause somewhere in each T-unit is 1 in 20; for a skilled adult the likelihood is 1 in 4, five times as great.

To get some slight indication of whether the number of adjective clauses per T-unit would be radically different in mature fiction, as contrasted with nonfiction, the investigators analyzed Hemingway's Short Happy Life of Frances Macomber and Faulkner's Barn-Burning, excluding all sentences containing direct discourse. The score for Hemingway was found to be .20 adjective clauses per T-unit, and for Faulkner .30, certainly comparable to the score of .26 for the nonfiction in Harpers and Atlantic. Perhaps subject matter has little influence.

It will be seen in the next two sections that the incidence of adverb clauses and noun clauses is nowhere near so strong and steady an index of maturity from early childhood to maturity, and that the incidences of noun and adverb clauses are especially insignificant among the older groups.

5-8. The frequency of noun clauses

In the writings studied for CRP 1998, almost a twelfth of the sentences written by fourth graders contained direct discourse, whereas for twelfth graders only about one hundredth did. One cannot possibly suppose that the twelfth graders had become syntactically incapable of producing direct discourse. The explanation is surely, instead, that in school as students get older they tend to write on subjects which elicit less of it. The impression that the frequency of direct discourse is related to some factor such as subject matter is inescapable.

The impression that indirect discourse is also subject-linked is likewise hard to escape. Students assigned the task of summarizing what someone said in an essay, or comparing two sets of beliefs or attitudes are especially likely to use noun clauses after verbs like "believed," "felt," "said," "thought," "arugued." Indirect questions similarly follow verbs like "wondered," "asked," "questioned," etc.

While direct discourse has been excluded from the writings to be examined here, indirect discourse and indirect questions have not, and, in fact, they constitute almost all of the noun clauses that appear in these writings.

While reading the themes of the older writers and tabulating the noun clauses, the investigators repeatedly noticed that one theme on one kind of subject would be full of noun clauses while another theme by the same student on a different subject had almost none. They noticed also that one assignment would elicit many noun clauses from many students, but another assignment would elicit few from anyone.

In any event there is no decisive evidence in these writings that the frequency of noun clauses is related to chronological or mental

maturity. Looking first to the three older groups, instead of the younger, (Table 7) we find wide variations among them. Average twelfth graders write more than twice as many per thousand words as their superior counterparts do, and write almost twice as many as skilled adults do.

TABLE 7 - FREQUENCY OF NOUN CLAUSES

	Ave. G 4	Sup. G 4		Ave. G 12	Sup. G 12	Skilled adults
that or Ø, etc.	105	134		262	136	143
Indirect questions	69	65		85	26	53
Total	174	199		347	162	196
No. per T-unit	.089	.100		.276	.141	.218
% of Ave. G 12	32%	36%		100%	51%	79%

In fact, the two superior older groups write about the same number of noun clauses per given number of words as the two groups of fourth graders do. So the evidence given by the number of clauses for equal numbers of words is strongly against significance.

If, however, we look to the number per T-unit for all five groups, there is a perceptible increase with age. But with superior fourth graders producing .10 per T-unit, and superior twelfth graders producing only .14, the increase is far from significant.

In the short stories already mentioned, the one writer produces noun clauses about as often as the other. The two frequencies are

.11 and .12 per T-unit. Those scores are slightly above the frequency of superior fourth graders, but less than half the scores made by average twelfth graders. Again it seems inescapable that the differences are affected by something other than any hypothetical inferiority of Faulkner and Hemingway to average twelfth graders.

In view of this evidence noun clauses certainly do not seem to be related to maturity either chronological or mental. Instead they seem to vary in response to some factors having nothing to do with maturity, probably in response to subject matter. Perhaps average fourth graders write noun clauses whenever the need arises and so do skilled adults, and that is all we can say from this evidence.

5-9. The frequency of movable adverb clauses

CRP 1998 found that the frequency of adverb clauses did increase through grades 4, 8 and 12, but the differences were not statistically significant. The numbers per T-unit were .10, .16, .21.

From the data in this study one is tempted to say that the frequency of adverb clauses is a statistically significant index of mental maturity for the younger writers, though for older writers it is not.

The difference between the two groups of younger writers is significant at the .005 level, by the Wilcoxon rank sum test.

However, among the older groups the evidence points clearly to nonsignificance, for the average twelfth graders (Table 8) score higher than either their superior classmates or skilled adults, and the superior twelfth graders are barely above superior fourth graders.

Further evidence that, among older writers at least, the number of adverb clauses is related to some extraneous factor such as subject

matter, rather than to maturity is borne out by the fact that the two short story writers use .323 and .252 such clauses per T-unit, both figures distinctly higher than those for any of the five other groups.

TABLE 8 - FREQUENCY OF MOVABLE ADVERB CLAUSES

	Ave. G 4	Sup. G 4		Ave. G 12	Sup. G 12	Skilled adults
Total occurrences	199	276		256	171	181
No. per T-unit	.101	.139		.212	.149	.202
% of ave. G 12	48%	66%		100%	70%	95%

In view of all this one cannot assert that when subject matter is allowed to vary freely, the number of adverb clauses is a significant index of maturity for older writers. That index is strongly affected by factors other than maturity. Perhaps narrative subject matter encourages it. However, among younger writers the index may be significant of maturity, and the fact of its significance may be due partly to the fact that fourth graders write on a narrow range of subject matter.

5-10. Words that introduce movable adverb clauses

Already it has been noted that superior fourth graders write significantly more movable adverb clauses than average fourth graders do. A glance at Table 9 shows what word introduces that increased number: it is when. The increase for other words is trifling by comparison.

There is no reason to suppose that the superior students created more opportunities where two main clauses could have been joined by the connector when, though of course that may have been the case. It seems more likely that they simply were more aware of those possibilities which both groups created. By joining the two with this connector they made explicit a connection which otherwise the reader would need to make for himself, if it was to be made.

While not all when's indicate the temporal relation of simultaneity of two events, as a glance at the dictionary senses of the word will show, it seems safe to assume that the great majority do.

It can be said that in the fourth grade about half the movable adverbial clauses are when clauses.

Older writers, at least when the amount of narration is relatively small, produce no where near that large a proportion of when clauses. Of all their movable adverb clauses, only about 15 - 25% are when clauses, instead of about 50% for the younger writers. The decrease in number of while clauses among the older writers may go hand-in-hand with the decline in when's, since both words commonly indicate simultaneity.

The increase in as clauses may be significant, but since the word has several different dictionary senses, no interpretation should be made without more information.

Obviously older writers have a wider repertoire of expressions for introducing movable adverb clauses.

TABLE 8 - FREQUENCY OF SUBORDINATORS

	Ave. G 4	Sup. G 4	Ave. G 12	Sup. G 12	Skilled adults
when	88	140	50	39	32
whenever		1			1
whenever or wherever					2
even when			1		
if or when			1		
if	27	32	73	30	34
even if			2	3	
as if (see when and if, or when)					3
because	34	33	38	21	18
because how...?			1		
as		3	21	34	20
just as	2		1	3	1
while	13	15	5	7	2
until	3	10	8	1	5
not until			1		
till	1	2	1	1	
after	6	13	9	1	8
right after	1				
before	2	6	10	4	8
just before			1		
so	5	4	2		1
so that	2	6	9	1	
since	2	4	8	5	6
ever since	1				
like	6	2	1	1	
like when	1	1			
where	3		1		
although			3	4	3
though		1		3	10
even though	2	2	2	3	3
unless		1	4	2	1
once			2	2	
except that					1
whether			1	3	2
whether or not					1
whereas			1		2
special "which"			3		
no matter what	1		1		
no matter how			3		2
no matter if			2		
wherever				1	
in that				1	
insofaras					1
however					1
where				1	11
so long as					1
whatever					1
Total	199	276	266	171	181

While syntactic analysis of the sort used here encourages the notion that adverbial clauses are an entity, as indeed syntactically they are, for language development purposes it might be well to note that many clauses which can be related to each other by a subordinator can also be related with the same result by a coordinator or by a wide variety of prepositional phrases, conjunctive adverbs, etc.

5-11. The proportion of the three kinds of clauses

For the two younger groups the proportion of the three common kinds of subordinate clauses is about the same (Table 10). But when

TABLE 10 - PROPORTION OF THREE KINDS OF SUBORDINATE CLAUSES

	Ave. G 4	Sup. G 4		Ave. G 12	Sup. G 12	Skilled adults
No. of noun clauses	174	199		347	162	196
Proportion of total	37.3%	31.7%		42.2%	28.3%	32.2%
No. of adjective clauses	93	151		209	238	232
Proportion of total	20%	24.1%		25.4%	41.6%	38.1%
No. of adverb clauses	199	276		266	171	181
Proportion of total	42.7%	44.1%		32.3%	29.9%	29.7%
Total of 3 kinds	466 100.0%	626 99.9%		822 99.9%	571 99.8%	609 100.0%

TABLE 11 - SUMMARY OF SUBORDINATE CLAUSES

	Ave. G 4	Sup. G 4		Ave. G 12	Sup. G 12	Skilled adults
Noun clauses						
that or Ø, etc.	105	134		262	136	143
indirect questions	69	65		85	26	53
Subtotal	174	199		347	162	196
No. per T-unit	.089	.100		.276	.141	.218
% of Ave. G 12	32%	36%		100%	51%	79%
Adjective clauses	93	151		209	238	232
No. per T-unit	.047	.076		.166	.207	.258
% of Ave. G 12	29%	46%		100%	125%	155%
Movable adverb clauses	199	276		266	171	181
No. per T-unit	.101	.139		.212	.149	.202
% of Ave. G 12	48%	66%		100%	70%	95%
Total of noun, adj., mov. adv. clauses	466	626		822	571	609
No. per T-unit	.237	.315		.654	.497	.678
Others						
clauses of comparison	8	14		10	14	21
adjective complement clauses	7	9		13	6	6
word order subjunctives	0	0		2	3	1
cleft sentences	0	1		18	0	2
deferred subject sentences	15	1		37	6	12
"the more the merrier"	0	0		5	3	1
Subtotal	30	25		85	32	43
No. per T-unit	.016	.013		.068	.028	.047

we move to the three older groups we see that the proportion varies widely from group to group without any apparent relation to maturity except for the general tendency, already emphasized, for adjective clauses to increase with maturity. Perhaps adverb clauses and noun clauses vary with the subject matter and the variation in subject matter among younger students is narrow but the variation among older writers is wide.

5-12. Conclusions (Table 11)

1. Among the three kinds of subordinate clauses frequently used, only one provides a highly significant index of both chronological and mental maturity from grade 4 to maturity. Those are adjective clauses.

2. There is no evidence that noun clauses are a significant index of maturity.

3. The number of adverb clauses appears to be a significant index of mental maturity in the fourth grade, but those clauses are not significant of mental or chronological maturity for older groups. CRP 1998 found no statistical significance for differences in number of adverb clauses in grades 4, 8 and 12.

4. As an index of maturity from grades 4 to 12, the subordinate clause index is as strong as it is only because it counts adjective clauses. It is weakened by the presence of adverb and noun clauses.

This fact may provide a clue which will help later researchers to find more significant measures of maturity than are provided by T-unit length and the subordinate clause index.

CHAPTER 6 THE COMPLEXITY OF NOMINALS WRITTEN BY SKILLED ADULTS

6-1. The structures that make clauses longer

CRP 1998 found that the clauses written by students of average IQ in grades 4, 8 and 12 tended to increase significantly in length. To see what caused that increase, or at least to see which structures occurred more often in the clauses written by older students, a fairly elaborate analysis of each clause was undertaken. Some structures were found to occur more often, some did not.

The present study is not concerned with the structures which showed no significance for maturity in CRP 1998, but is concerned with the others in the writings of skilled adults.

The purpose of the present section is simply to see whether skilled adults seem to lengthen their clauses and T-units by using still more of the same structures which schoolchildren learn to use more often and which correlate with the length of the larger syntactic units.

6-2. The increase in modifiers of nouns

The place where CRP 1998 found the greatest expansion contributing to clause length was in the nominals, that is, in the structures that served as subjects, direct objects, predicate nominals, etc. of clauses. Those expanded nominals often consist of a noun with a wide variety of modifiers: adjectives, the genitives of nouns and pronouns, phrasal genitives, participles, infinites, uninflected nouns, etc. The frequency of each of these kinds of modifiers was tabulated for each student, and totals were given for each grade. Usually it was found that the number increased significantly from grade to grade.

The total number of such nonclause mofifiers was found for grades 4, 8, 12 respectively to be 1,582; 2,147; 2,367. The average number of them per clause was found to be .6, .95, 1.1. In percentages of twelfth grade performance, the number per clause is 55 per cent, 86 per cent, 100 per cent. The number per clause nearly doubles.

Further statistical analysis since the publication of CRP 1998 has correlated the number of each of these modifiers of nouns for each student with his clause length. The clause length correlations which are statistically significant are these: with adjectives, .547; with inflected and phrasal genitives, .396; with prepositional phrases not containing of, .567; with infinitives, .431; with present participles, .278. The correlation of clause length with the number of unmodified nouns and pronouns is high and negative, -.839. It is clear, then, that the increase in the number of modifiers of nouns is a major factor in the lengthening of clauses as students mature.

The statistically significant contingency coefficients for the various nonclausal modifiers of nouns have been found, since the publication of CRP 1998, to be these: adjectives .370; genitives .520; prepositional phrases .481; infinitives .368; past participles .369; present participles..336.

From Table 12, which reviews some of the figures from CRP 1998, and adds the figures for skilled adults, it is clear that the skilled adults write still more in nearly every category. The total number per clause grows from .6 for fourth graders to 2.0 for skilled adults.

6-3. The significance of the increase in modifiers of nouns

These findings take on significance and interest in view of the demonstration by the generative--transformational grammarians that the

TABLE 12 - NUMBER OF NONCLAUSE MODIFIERS OF NOUNS

	Data below from CRP 1998			Skilled adults
	G 4	G 8	G 12	
Adjectives	554 60%	895 98%	917 100%	1,044 113%
Genitives, inflected and phrasal	632 78%	652 81%	809 100%	1,006 124%
Prepositional phrases	133 42%	229 72%	318 100%	473 149%
Noun adjuncts	157	205	127	351 276%
Nonfinite verbs	100 52%	162 84%	192 100%	374 195%
Single-word expressions of place	6	4	4	30
Total	1,582 67%	2,147 90%	2,367 100%	3,278 138%
No. per clause	.6	.95	1.1	2.04
No. per T-unit	.74	1.54	1.86	3.60

meaning expressed by each one of these modifiers related to its head noun is related to the meaning of a full sentence containing the same noun and the same modifying expression. For instance, the meaning expressed by the two sentences "The cat is gray" "The cat scratched me" is expressed by the single sentence "The gray cat scratched me" or by "The cat that is gray scratched me." In the last sentence, what originally was a main clause with a predicate adjective has become a subordinate clause, an adjective clause with a predicate adjective. In the next to last sentence ("The gray cat scratched me") all of that subordinate clause has disappeared except the adjective, and the adjective now modifies the same noun which once stood as the subject of its sentence. This process of reducing whole main clauses to single word modifiers which are consolidated into other clauses will effect clause length in this way: what originally were the two clauses totalling 8 words, thus averaging 4, become one clause 5 words long, that is 1 word longer. This is one of the ways in which average clause length is increased.

Another beneficial result of this process of clause consolidation is that 3 words out of 8 can be thrown away. This deletion of 3 words is important too. A study of the present sort can measure the extent to which clauses are lengthened, but it cannot measure directly the far more impressive extent to which words are thrown away by older writers. Throwing away unneeded words produces succinctness, conciseness. In a rough sense, longer clauses take fewer words, they are more concise.

6-4. The increase in nominalized sentences

The second way in which nominals can be lengthened is by a process which converts all or part of a sentence into a single nominal. This nominal then functions as the subject, object, predicate nominal, etc. of a more comprehensive sentence.

Noun clauses are one form of the nominalized sentence. Another form is the gerundive nominal (His driving the truck at night is forbidden). Another form is the infinitival nominal (For him to drive the truck at night is forbidden). The two examples are obviously related to the sentence "He drives the truck at night." Nominalized sentences can be very long and highly complex, and they lengthen the T-units which contain them. If the nominalized sentences are infinitivals or gerunds, which do not count as clauses themselves, then they often lengthen the clauses which contain them.

CRP 1998 found that the number of nominalized sentences increased with the age of the writers. Statistical analysis since the publication of that study indicates that clause length correlates significantly with the number of gerunds (.557), and that, in addition, T-unit length correlates significantly both with the number of gerunds (.660) and with the number of infinitival nominals (.368). The contingency coefficient for factive infinitivals is .391 and for gerunds is .469.

6-5. A "complexity" count for nominals

As one analyzes the writings of younger children he gets the impression that older students not only produce more modifiers of nominals but also that they can attach a larger number of modifiers to a single head noun. For instance, a fourth grader writes these two clauses, "Dick was Billy's brother. Dick was younger than

Billy." An older writer would reduce the second clause to a second modifier of "Billy," writing "Dick was Billy's younger brother."

Another wrote, "The film was about a white-headed whale who was very big." An older writer would add a second modifier to "whale," writing, "The film was about a very big white-headed whale."

A fourth grader almost never attaches as complicated a set of modifiers to one head as did the eighth graders who wrote of "a rare white whale with a crooked jaw" or, "a fat, short, dull-looking man." The former is related to (1) "The whale was rare," (2) "The whale was white," (3) "The whale had a jaw," (4) "The jaw was crooked." Four modifiers in one nominal is too many for a fourth grader to produce. The other expression is related to (1) "The man was fat," (2) "The man was short," (3) "The man looked dull."

To quantify this impression that the number of modifiers and nominalized verbs or clauses contained in a single nominal increases with maturity, a so-called "complexity count" was undertaken. For every nominal, a count of one was given each time one of the following structures appeared.

Modifiers of nouns

Adjectives. Only words which can occupy predicate adjective positions were counted. Articles, demonstratives, cardinal and ordinal numbers, etc. were not. Adverbs which modified adjectives were ignored in this count.

Noun adjuncts. In this category are uninflected nouns modifying other nouns. Examples are "art lesson" and "apple pie." Noun-noun expressions which appear as entries in Websters Third International were not counted here, but were counted instead as single words.

Possessive pronouns

Genitives of nouns, both inflected and phrasal

Prepositional phrases. All of phrases were counted with genitives.

Nonfinite verbs

Appositives

Adjective clauses

Nominalized verbs and sentences
noun clauses
gerund nominals
infinitival nominals (interrogative and factive)

In Table 13 is shown, for each of the grades in CRP 1998, the number of nominals that received the count of 1, the number that received the count of 2, etc. If one reads the table from the bottom up, ignoring skilled adults, he sees that the one nominal given the count of 9 was produced by a twelfth grader. Two nominals received the count of 8, and again twelfth graders produced both. Two were given the count of 7, and again only twelfth graders produced them. Nominals given the count of 6 were produced 12 times by twelfth graders, but now eighth graders put in an appearance with 3. For nominals with a count of 5 even fourth graders appear, but they produce only 3 whereas the older grades produce 11 and 17. For the next three lines, for counts 4, 3, and 2, the older grades maintain a substantial lead. But when we get to nominals given the count of 1, and nominals given the count of 0 (pronouns and unmodified nouns), then the youngest students produce the most.

After CRP 1998 was completed, further tests for the significance of these differences were made, and certain correlations with T-unit length and clause length were computed.

For each individual, three sets of scores were obtained. One was simply the total number of counts given to all his nominals. A

TABLE 13 - NUMBER OF NOMINALS RECEIVING THE VARIOUS COUNTS

Number of counts	G 4	G 8	G 12	Skilled adults
0	3,865	3,045	2,507	1,185
1	1,534	1,466	1,695	781
2	228	400	458	335
3	38	125	150	232
4	9	31	36	120
5	3	11	17	66
6	---	3	12	41
7	---	---	2	30
8	---	---	2	9
9	---	---	1	12
10	---	---	---	5
11	---	---	---	7
12	---	---	---	3
13	---	---	---	6
14	---	---	---	4
15	---	---	---	5
16	---	---	---	0
17	---	---	---	1
others	---	---	---	3

second was the total number of counts given to nominals receiving the count of 2 or more (ignoring all nominals receiving the count of 1 or zero). The third was the total number of counts given to nominals receiving the count of 3 or more (ignoring nominals with the count of 2 or 1 or zero).

These three scores for each individual were then tested statistically. By analysis of variance each of the three measures was found to be significant for grade (not for sex nor for the interaction of grade and sex) at the .01 level. Each of the three was found to have a high contingency coefficient, the highest being .66 for total counts given to nominals receiving the count of 3 or more. We can conclude that this is a highly significant measure of maturity.

The complexity count also measures factors which contribute strongly to the length of T-units. For instance, the "total counts for nominals receiving counts of 2 or more" correlated .769 with T-unit length.

When all adjective clauses and noun clauses were excluded from the complexity count, the total number of counts for each student was found to correlate highly (.732) with his clause length score. It is thus confirmed that the number of more and more complex nominals is a major factor in the increase in clause length.

The kind of information given in Table 13 has a further value. It shows the limits to the number of these items that can be combined at one time by the various grades. The table might be summarized in these rough terms: less often than once in a thousand words can fourth graders get more than 3 counts, eighth graders more than 4, or twelfth graders more than 5.

"Dick's younger brother" gets 2 counts and can be handled by many fourth graders. "A fat, short, dull-looking man" gets 3 counts and can be handled by many eighth graders. "A rare white whale with a crooked jaw" gets 4 counts and few eighth graders accomplish that.

6-6. The complexity of nominals written by skilled adults

Added to the figures for the three grades in Table 13 are the figures for skilled adults. Obviously the developmental tendencies shown to occur for schoolchildren are carried much farther by skilled adults. They write many more nominals with high counts and fewer nominals with low counts.

The consolidation of clauses and the lengthening of T-units by the process described earlier in this study as the reduction of sentences to modifiers of nouns and nominalized sentences is carried much farther by skilled adults than by schoolchildren.

CHAPTER 7 - CONCLUSION

7-1. Summary of the findings

This study has made two kinds of contributions: one kind concerns the procedure for studies of the syntactic development of students, the other gives us further information about that development.

7-2. Procedural recommendations

1. If the results of syntactic research are to be fully comparable from one investigator to another it seems advisable to separate declarative sentences not containing direct discourse from other sentences. The other sentences would be questions, answers, imperatives, sentence fragments, and sentences containing direct discourse. Such separation is particularly advisable if the number of sentences in the second category is large. In this study sentences in the second category were not analyzed.

In 18,000 words of fourth grade writing the proportion of writing in sentences of the second category was about 8%. Excluding such sentences did make a difference in the five synopsis scores, though the difference was not significant. The exclusion of such sentences, or at least their separation, makes for a cleaner technique which in the long run may be rewarding.

2. The "subordinate clause index" is defined as the number of clauses divided by the number of T-units (or by the number of main clauses) for any body of writing. This index is more useful and more readable, though not more valid, than the number of subordinate clauses divided by all clauses, which is called the "subordination ratio."

The "main clause coordination index," defined as the number of T-units (or main clauses) divided by the number of sentences is a useful index for relating the length of T-units to the length of sentences.

The Synopsis of Clause-to-Sentence Length Factors contains five figures which are useful for describing the syntactic characteristics of different writers, and for observing certain developmental trends among maturing writers. Those five figures may be thought of as three lengths related by two ratios, or, instead, as five quotients or ratios. In order, the five are words/clauses, clauses/T-units, words/T-units, T-units/sentences, words/sentences. The first is mean clause length the third is mean T-unit length, the fifth is mean sentence length. For any body of writing, whether as long as a book or as short as a sentence, the first figure times the second equals the third, and the third times the fourth equals the fifth.

The figures given as the group means in this study have been the means of the individual scores, the means of the individual means. It is also of course possible to regard the writing of the 18 individuals in each group as a single body and compute means from it. These second means are ordinarily negligibly different from the group means figured the other way.

The concept of the T-unit was introduced in CRP 1998 and was defined as one main clause plus whatever subordinate clauses are attached to it. There can be no doubt that, at least in the early grades, T-unit length is a more valid index of maturity than is sentence length. The fact that superior students write shorter

sentences is further evidence T-unit length should displace, or at least supplement, sentence length in the syntactic development studies of the future. In fact, all five synopsis figures can be recommended, though in studies of speech in the early grades, it is doubtful that the last two figures, have much, if any, meaning.

3. The "complexity count" for nominals has important theoretical value, for it gives information as to what it is that older students do to make their T-units and clauses longer. It tells us something we must teach for, if we are to stimulate growth in clause length.

The complexity count, however, is exceedingly laborious, and is not to be recommended as an efficient measure of maturity. However, it does indicate the kind of inquiry which further research should make. Eventually, the study of structures inside the clause should give us far deeper insight than we now have as to the details of syntactic maturity. For getting deeper insight into the finer matters of syntactic growth much better instruments than the complexity count can be devised.

7-3. Further information about syntactic development

1. The five Synopsis figures provide us with some statistically significant information about the differences between the writings of students of average IQ and superior IQ in both the early grades and the late grades.

In the fourth grade the T-unit length of superior students is significantly greater than it is for average students, indicating that their superior endowment has already asserted itself in their syntax.

The superiority in T-unit length is due to a significant increase in the number of subordinate clauses, and that, in turn, is due to a significantly larger frequency of adjective clauses and adverb clauses, but not noun clauses.

As early as the fourth grade the clause length of superior students did not yet differ from that of average students, though as they grow older we can predict with confidence that the superior students will write longer clauses. The sentences of superior fourth graders are actually shorter than those of average fourth graders, and that is due to the fact that they write fewer T-units per sentence. They punctuate better.

By the time students of superior IQ reach the twelfth grade it is not the number of subordinate clauses that distinguishes them, for their classmates of average IQ are, by this stage of maturity, already writing about as many subordinate clauses in general as anybody--at least about as many as skilled adults writing nonfiction. If any further subordinate clause growth is to occur for twelfth graders, it will probably be in the number of adjective clauses, not adverb or noun. Anyhow, superior twelfth graders do write more adjective clauses than average twelfth graders, and skilled adults write still more. But no such superiority exists with respect to adverb or noun clauses. Average twelfth graders write about as many of them as any of the others do.

What does instead distinguish superior students from average by the time they reach twelfth grade is still their T-unit length, but more especially their clause length. One way to indicate the magnitude of that superiority is to say that superior twelfth graders

are farther ahead of their average classmates than those students are ahead of average fourth graders. Superior twelfth graders are closer to skilled adults than to their average classmates.

The sentences written by superior twelfth graders are actually shorter than those by their average classmates, though the difference is not statistically significant. They write fewer T-units per sentence.

3. The skilled adults who write nonfiction articles for Harpers and Atlantic carry still further in their syntax the developmental tendencies remarked in CRP 1998 and in the new materials summarized above.

Their T-unit length is much greater, primarily because their clause length is much greater.

7-4. Suggestions for further research

At the close of this study the general method of syntactic analysis employed in CRP 1998 looks sufficiently valid and insightful to be worth carrying further. The body of writing examined is now doubled, reaching more than a hundred thousand words. In general, the developmental tendencies found to occur between grades 4 and 12 have now been shown to be carried much farther in the work of skilled adults. Furthermore, the measures employed are sufficiently sensitive to detect mental maturity as well as chronological. These instruments may, then, be recommended for further use.

There are obvious gaps in our information. These measures have not, to the writer's knowledge, been applied as yet to average adults, or to the kinds of adults that average twelfth graders become. Though we now have measurements for average and superior students at two stages in the developmental sequence, we lack comparable figures for

stages in the developmental sequence, we lack comparable figures for students with IQ below average. Surely we ought to find out whether the students now called disadvantaged ever achieve full syntactic maturity. If different investigators employ replicable measures, the information accumulated through their efforts will eventually become norms.

Within the last two years a study by O'Donnell, Griffin and Norris at Peabody has contributed substantially to our knowledge. It demonstrates that T-unit length is a significant measure of development in speech as well as writing, and that T-unit length in speech increases through grades K, 1, 2, 3, 5, and 7. It also compares, with most interesting results, the speech and the writing of the same students in grades 3, 5 and 7. This study will be published as a Research Report by the NCTE within a few months.

In progress by the present investigator is a study of the syntactic factors in readability. Though the statistical analysis is not yet complete, certain conclusions can be drawn tentatively. Apparently the sentences written by adults for children in the middle grades--or, more properly, written to be read easily--have some of the characteristics of the sentences written by children themselves, but also some of the characteristics of adult rather than children's writing.

Of the five Synopsis figures, two seem not to be related to readability. That is, they tend to remain constant at approximately an adult level whether the sentences are easy or hard to read. Those two measures are the number of clauses per T-unit and the number of T-units per sentence.

The other three measures do increase with difficulty, but all the significance of that change lies within only one of them. That one is clause length. As difficulty increases and readability decreases, it is clause length that increases steadily. But since the number of clauses per T-unit is virtually constant in these materials, T-unit length goes up at the same rate as clause length. And since the number of T-units per sentence is virtually constant, sentence length goes up at the same rate as T-unit length and clause length.

These findings lead to three further conclusions. One is that sentence length is as valid as any other of the five figures for indicating the syntactic factor in readability.

The second implication is that if sentence-attack skills are useful in the teaching of reading just as work-attack skills are, then those sentence-attack skills should focus on the structures which contribute to increased clause length rather than to the other four indexes in the synopsis.

And the research already completed here and in CRP 1998 gives at least some indication of which those structures are. They are the sentence-combining transformations, or the clause-consolidating processes.

It will surprise no one that the readability study shows that students can read sentences more mature than those they can write, or do habitually write. This is to be expected, for it is well known that children read words far more mature than those they write or speak. Furthermore, the skilled writer avoids the syntactic and rhetorical awkwardnesses which escape quantitative analysis, so his sentences are more comprehensible than less skillful sentences that would measure "equally mature" by a quantitative measure.

It may be less widely known, however, how great this difference is. Apparently students in the middle grades can read with 80% comprehension sentences whose clauses are as long as those they will write only when they have become about four years older. They can read syntax that is about four years beyond what they can write.

These studies in readability, in speech, and in writing indicate that significant results are obtainable from future studies using T-unit length and the other synopsis scores.

7-5. Implications for the curriculum

There is no doubt that people can learn, as they mature, to speak, write and read complicated sentences without any regular instruction in language structure. That they do learn better and faster if they get regular instruction is an article of faith if not a demonstrable fact.

This research suggests that, somewhere through the school grades, children might profit by studying how a set of simple sentences is related to one complicated sentence saying the same thing. They might also profit by studying the reverse process. The process of combining simple sentences into complicated ones is the task of the writer and speaker. Breaking complicated sentences down into simple ones is the task of the reader and listener.

The count on complexity of nominals gives us some idea of how many simple sentences are now being combined at the various grade levels. Once or twice in a thousand words average fourth graders combine three into one nominal; equally often eighth graders combine four, and twelfth graders five. Skilled adults combine seven with about that frequency.

If children are to be challenged or even interested by such instructional exercises, they may need to be given tasks at least as difficult as those they sometimes perform unconsciously.