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ABSTRACT

Six passages were used in this study to investigate the recoding behavior of eighth and ninth grade students for both increase and decrease in syntactic complexity and thus gain a more accurate picture of their grammar. Each of the two selections used was written in kernel sentences at the eighth grade level of writing and the skilled adult level of writing. The teacher was asked to distribute a packet containing the test passages without any verbal assistance. The instructions asked the student to read the paragraph and then rewrite it in a better way without leaving out any of the information. Results indicated the ninth grade subjects rewrote the passages using longer T-units and clauses than did the eighth grade subjects. Further, the students seemed to comprehend all that the input passages stated. This implied that while the students may not have produced syntactic structures at the skilled adult level, they could nevertheless comprehend writing at that level. (HOD)

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SYNTACTIC RECODING OF PASSAGES WRITTEN AT THREE LEVELS OF COMPLEXITY

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TABLE OF CONTENTS

TABLES

Most current theories of language acquisition and development are alike in one respect: they hypothesize that acquisition follows a sequence of increasingly complex grammars, the first grammar being the least complex, the last being the highly complex "adult" grammar. Each successive grammar adds more of the features of the adult model.

To test this hypothesis, investigators have looked at the language of children of varying ages, and in general have found the hypothesis valid. It is recognized by all that, by the time a child begins school, most of the features of the adult grammar have been incorporated into the child's grammar. However, the grammar of the first grader is considerable different from that of the adult, and the primary difference seems to lie in the ability to utilize the features of the adult grammar.

There have been several studies on the development of written language in school children. (Hunt, 1965, 1966; O'Donnell, Griffin, and Norris, 1967; and others). An additional study by Hunt (1970) investigated developmental trends in the syntactic performance of pupils in grades 4, 6, 8, 10, and 12 and from skilled adult writers, using a totally controlled input. All subjects were given a paragraph concerning the manufacture of aluminum and written in kernel sentences. The subjects were asked to rewrite the paragraph "in a better way" without adding or omitting information. The rewrites were then analysed for their syntactic characteristics.

The syntactic analysis took two forms. First, each rewrite was analyzed for the number of words per T-unit, per clause, and per sentence, the number of clauses per T-unit, the number of input kernels which appeared in the rewrite in less than clausal form, and the number of input kernels omitted in the subject's rewrite. Second, the transformational history of each kernel in the stimulus paragraph was determined for each rewrite. In both analyses, information added by the subject was deleted.

The results of the first analysis indicated that older subjects wrote more complexly; i.e., they incorporated more of the input into each T-unit and clause, thus producing longer T-units and clauses. The results of the second analysis presented a frequency-of-use picture of the transformations appearing at each grade level; e.g., at each successive level the passive transformation was used more often than at the preceding level, but the main clause coordination transformation was used less often than at the preceding level.

While the results were essentially the same as previous research had shown, the procedural difference in gathering the data is noteworthy. In the previous studies much less rigorous control was placed on the input from which the subjects constructed their sentences; indeed, prior to the O'Donnell et al. (1967) study, the data were from free-writing samples, i.e., there was no control. O'Donnell, et al. (1967) showed subjects silent movies as the stimuli, thus providing the students with a common content framework, but still not fully controlling the concepts a student might use in his writing. In the Hunt (1970) study, only the concepts present in the stimulus paragraph were analyzed. All extraneous material was excluded. Thus the student who knew a lot about the subject or who had a vivid imagination was not especially advantaged. This technique also controlled for differences between highly verbal students and those less verbal. Consequently, it was possible to compare students more accurately on ability to utilize syntactic resources.

Slobin and Welsh (1968), in a study of the oral language of preschool children, used a different technique. They presented the child a sentence and asked him to repeat it. If the sentence was too long to be stored in the child's immediate memory, he reformulated that sentence reducing the complexity, yet retaining the essential meaning. For example, in response to "John who cried came to my party", the child responded "John cried and he came to my party" or in response to "The man who I saw yesterday got wet", the child responded "I saw the man and he got wet". It could be inferred that the child was reducing the syntactic complexity to his own productive level.

Results essentially the same as those of Slobin and Welsh were obtained by Midkiff (1971) in his investigation of 4, 5, 6, and 7 year-old children's use of relative clauses and adjectives. The results of these two studies and others indicate that the child decodes the message to determine the semantic essentials, then recodes it into a syntactic form appropriate to his own productive grammar. The resulting form would, then, depend upon the developmental stage of the child.

The Hunt (1970) study, by using kernel sentences (simple sentences containing only one idea) investigated only the students' ability to increase complexity. In the present research, Hunt's finding were used as a basis for combining his and Slobin and Welsh's techniques so that students could be given stimulus passages written at various levels of syntactic complexity. Thus, the student could be given a passage written in a more sophisticated (i.e., more syntactically complex) style, a passage written at his own level of complexity, and one using less syntactic complexity. Furthermore, because the stimuli were presented in written form, the memory variable, which was crucial to Slobin's results, was controlled. The purpose of the present study, then, was to investigate the recoding behavior of the students for both increase and decrease in syntactic complexity and thus gain a more accurate picture of their grammar.

HYPOTHESES

Seven hypotheses were developed, three concerning increase in complexity, three concerning no changes in complexity, and one concerning a decrease in complexity, complexity being determined by the number of words per T-unit (W/T-U) and words per clause (W/CL). The hypotheses are stated as follows:

1. The subjects would increase complexity when rewriting the kernel input paragraph.

2. The output of the subjects' rewriting of the skilled adult input paragraph would be greater in complexity than the output of the subjects' rewriting of the kernel input paragraph.
3. The output of the subjects' rewriting of the skilled adult input paragraph would be greater in complexity than the output of the subjects' rewriting of the eighth grade input paragraph.
4. The subjects would not change the complexity of the eighth grade input paragraph when rewriting it.
5. The output of the subjects' rewriting the kernel input paragraph and the output of the subjects' rewriting of the eighth grade input passage would be the same.
6. The output of the subjects' rewriting of the kernel input paragraph would be the same as the eighth grade input paragraph.
7. The subjects would decrease the complexity when rewriting the skilled adult input paragraph.

PROCEDURE

Six passages were used in this experiment. Three were based on the "Aluminum" passage, three on a second passage, called "Bee," which concerned a bee's stinging: 1) the "Aluminum" paragraph written in kernel sentences; 2) the "Aluminum" paragraph written at the skilled adult level of writing; 3) the "Aluminum" paragraph written at the eighth grade level of writing; 4) the "Bee" paragraph written in kernel sentences; 5) the "Bee" paragraph written at the eighth grade level of writing; 6) the "Bee" paragraph written at the skilled adult level of writing.

The three "Aluminum" passages were derived directly from Hunt's (1970) data. The kernel input passage was the same as the one Hunt used. The eighth grade and skilled adult passages were prototypes derived from the analysis of Hunt's eighth grade and skilled adult rewrites. That is, after determining what Hunt's subjects typically did with each input kernel, the prototypes were written accordingly, keeping all the syntactic characteristic measurements as close to

Hunt's means as possible. For example, Hunt's data indicated that eighth graders normally used the first input kernel as the main clause of the first sentence. Consequently, the same kernel was so used in writing that prototype. The eighth graders normally converted about four input kernels into subordinate clauses. In the prototype, the number of subordinate clauses was increased to five, for if only four had been used, it would have necessitated unacceptable changes in other syntactic characteristics.

Thus, these paragraphs were simply the "Aluminum" passage as rewritten by "typical" eighth graders and skilled adults. These paragraphs were typical in the sense that they exhibited the syntactic characteristics of the average performance of an average group at both levels.

The "Bee" eighth grade and skilled adult passages were constructed by using the "Aluminum" data in order to produce a paragraph which was statistically appropriate in its syntax for those levels. Since the number of words and kernels were not the same in "Bee" as in "Aluminum", some adjustments had to be made. However, these adjustments did not disturb the proportional relationships between the various levels of writing. (See Smith, 1971, and in 1973, for more explicit elaboration). The syntactic characteristics of each of these passages is presented in Table 1.

TABLE 1

Syntactic Characteristics of the Stimulus Passages (Inputs)

Passage	Words	T-Units	Clauses	W/T-U	W/CL	CL/T-U
A K	130	32	32	4.34	4.34	1.00
A 8	120	13	18	9.23	6.67	1.38
A SA	93	6	9	15.50	10.33	1.50
B K	116	23	23	5.04	5.04	1.00
B 8	107	9	14	11.88	7.64	1.56
B SA	92	5	8	18.40	11.50	1.60

The subjects, 113 eighth graders and 90 ninth graders, were members of eight English classes in four Georgia high schools. The eighth grade was chosen to allow comparison to Hunt's eighth grade data. The ninth grade was chosen because if differences between the eighth and ninth grades exist, it is likely that other grades would also differ.

The teacher in each of the classes was given a packet containing test passages, one for each student. Each packet contained an equal number of each of the six test passages. The teacher distributed the passages, told the students to read the instructions, and collected the passages as the subjects finished. Subjects were allowed to write on the test sheet. If a subject did not write on the test passage, the teacher stapled the rewrite page to the test passage. No time limit was enforced; all students finished before the end of the class period. No verbal assistance was provided by the teacher. Each test passage included the following instructions:

> Read the following paragraph all the way through. Study the passage, then rewrite it in a better way. You may combine sentences, change the order of words, or omit words that are repeated too many times. But try not to leave out any of the information.

RESULTS AND DISCUSSION

The rewrites were analyzed using the techniques developed by Hunt (1965). Numbers of words, T-units, clauses, words per T-unit, words per clause, and clauses per T-unit were counted and group means calculated. All of these statistics are presented in Table 2.

TABLE 2

Means of Syntactic Characteristics of Rewrites (Outputs) of Each Group in Each Grade

Grade Level of Group	Stimulus Passage	Words	T-Units	Clauses	W/T-U	W/CL	CL/T-U
8	A K	111.28	12.32	16.96	9.43	6.76	1.40
8	A 8	111.78	10.94	16.11	10.94	7.17	1.52
8	A SA	85.00	6.54	9.79	13.08	8.66	1.50
8	B K	102.96	12.91	15.78	8.76	6.96	1.27
8	B 8	94.88	8.47	12.24	11.43	7.89	1.45
8	B SA	90.87	5.56	10.19	16.83	9.01	1.88
9	A K	112.95	11.90	17.05	10.03	6.97	1.46
9	A 8	110.07	10.27	15.80	11.27	7.06	1.59
9	A SA	82.47	6.07	9.20	14.49	9.10	1.60
9	B K	101.40	9.90	14.25	10.60	7.28	1.47
9	B 8	90.93	7.33	12.00	12.65	7.61	1.67
9	B SA	90.60	6.20	10.60	14.78	8.63	1.72

In Table 3, the confidence interval for each of the Output means on the Words per T-Unit (W/T-U) and Words per Clause (W/CL) scores are shown. Since the Input passages (the stimulus passages) were constructed by the experimenter, no variation could occur. Consequently, the 95% confidence intervals were calculated for the Output means to allow comparison of the Inputs with the Outputs, as well as comparison of the various Outputs with each other. Significance, then, was assumed when the Input did not fall within the range of the Output confidence intervals or when the confidence interval of two Outputs did not overlap. Because some of the hypotheses are directional and others non-directional, different confidence intervals result. Therefore, Table 3 indicates the non-directional confidence intervals for each of the Output means on W/T-U and W/CL scores and Table 4 indicates the directional confidence intervals for those means.

TABLE 3

Means of Syntactic Characteristics of Outputs (Table 2)
Non-Directionally Compared with Syntactic Characteristics of Inputs (Table 1)

Grade Level of Subjects	Stimulus Passage	N	W/T-U					W/CL				
			Output		95% Confidence Interval		Input	Output		95% Confidence Interval		Input
			Mean	S.D.	L	U		Mean	S.D.	L	U	
8	A K	25	9.43	2.13	8.54	10.32	4.34*	6.76	1.09	6.30	7.22	4.34*
8	A 8	18	10.94	2.86	9.48	12.40	9.23*	7.17	1.32	6.49	7.85	6.67
8	A SA	14	13.08	3.08	11.24	14.92	15.50*	8.66	1.07	8.10	9.22	10.33*
8	B K	23	8.76	2.65	7.59	9.93	5.04*	6.96	2.22	5.98	7.94	5.04*
8	B 8	17	11.43	1.62	10.58	12.28	11.88	7.89	.92	9.40	8.38	7.64
8	B SA	16	16.83	3.31	15.01	18.65	18.40	9.01	1.07	8.42	9.60	11.50*
9	A K	20	10.03	2.03	9.06	11.00	4.34*	6.97	1.50	6.25	7.69	4.34*
9	A 8	15	11.27	2.86	9.63	12.91	9.23*	7.06	.80	6.60	7.52	6.67
9	A SA	15	14.49	4.94	11.66	17.32	15.50	9.10	1.40	8.30	9.90	10.33*
9	B K	20	10.60	1.71	9.78	11.42	5.05*	7.28	1.01	6.80	7.76	5.04*
9	B 8	15	12.65	1.94	11.54	13.76	11.88	7.61	.74	7.19	8.03	7.64
9	B SA	5	14.78	1.73	12.38	17.18	18.40*	8.63	.70	7.66	9.60	11.50*

*Input passage not within the 95% Confidence Interval of the Output mean.

TABLE 4

Means of Syntactic Characteristics of Outputs (Table 2)
Directionally Compared with Syntactic Characteristics of Inputs (Table 1)

Grade Level of Subjects	Stimulus Passage	N	W/T-U					W/CL				
			Output		95% Confidence Interval		Input	Output		95% Confidence Interval		Input
			Mean	S.D.	L	U		Mean	S.D.	L	U	
8	A K	25	9.43	2.13	8.69	10.17	4.34*	6.76	1.09	6.38	7.14	4.34*
8	A 8	18	10.94	2.86	9.73	12.15		7.17	1.32	6.61	7.73	6.67
8	A SA	14	13.08	3.08	11.57	14.59	15.50*	8.66	1.07	8.20	9.12	10.33*
8	B K	23	8.76	2.65	7.79	9.73	5.04*	6.96	2.22	6.15	7.77	5.04*
8	B 8	17	11.43	1.62	10.72	12.14	11.88	7.89	.92	7.49	8.29	7.64
8	B SA	16	16.83	3.31	15.33	18.33	18.40*	9.01	1.07	8.53	9.49	11.50*
9	A K	20	10.03	2.03	9.22	10.84	4.34*	6.97	1.50	6.38	7.56	4.34*
9	A 8	15	11.27	2.86	9.92	12.62	9.23*	7.06	.80	6.68	7.44	6.67*
9	A SA	15	14.49	4.94	12.17	16.81	15.50	9.10	1.40	8.44	9.76	10.33*
9	B K	20	10.60	1.71	9.92	11.28	5.04*	7.28	1.01	6.88	7.68	5.04*
9	B 8	15	12.65	1.94	11.79	13.56	11.88	7.61	.74	7.26	7.96	7.64
9	B SA	5	14.78	1.73	12.94	16.62	18.40*	8.63	.70	7.88	9.38	11.50*

*Input passage not within the 95% Confidence Interval of the Output mean.

Hunt has presented data on the performance of eighth and tenth graders who rewrote the "Aluminum" passage in its kernel form (Hunt, 1970, see particularly pages 17 and 19). Since the data for constructing all of the stimulus passages in this experiment came from Hunt's data, it is possible to assume, if Hunt's data is reliable, that the eighth graders in this study should perform like Hunt's subjects. Specifically, the eighth graders' W/T-U and W/CL means should be the same as Hunt's eighth grade means both for the rewriting of the kernel input passage and the eighth grade input passage. Furthermore, the ninth graders in this study should perform better than Hunt's eighth graders but not as well as his tenth graders. Four of the above detailed hypotheses were derived from this assumption: the eighth and ninth graders would increase the complexity of the kernel input passages (Hypothesis 1), just as Hunt's subjects did. Further, since the eighth grade stimulus passages were based on Hunt's eighth grade data, the present eighth grade subjects should not significantly change the eighth grade stimulus passages when rewriting them (Hypothesis 4), nor should their rewriting of the kernel input passages differ from the eighth grade stimulus passages (Hypothesis 6). Finally, the subjects' rewriting of the kernel stimulus passages would not differ from their rewriting of the eighth grade stimulus passages (Hypothesis 5).

While the ninth grade subjects consistently wrote longer T-units and clauses than the eighth graders, there were no statistically significant differences between them. Thus, in testing these hypotheses, both grades will be considered as coming from the same population.

The results (Table 4) clearly indicate that the expected increase in complexity when rewriting the kernel stimulus passages did occur in each grade and on both the "Aluminum" and "Bee" passages. Thus, Hypothesis 1 is accepted. Hypotheses 5 and 6, however, cannot be fully accepted because the T-unit lengths of the eighth and ninth grade subjects' rewriting of the "Bee" kernel input were significantly different from either the eighth grade "Bee" input passage or the subjects' rewriting of that passage (Table 3). For essentially the same reason, Hypothesis 4 must be rejected (Table 3), for the subjects

did significantly increase the T-unit length when rewriting the eighth grade "Aluminum" stimulus passage. In all three cases, however, clause length was not significantly different. This apparently conflicts with expected high correlations normally reported between T-unit length and clause length. An increase in clause length does create a corresponding increase in T-unit length, but an increase in T-unit length does not necessarily depend on an increase in clause length; it could be caused by an increase in the number of dependent clauses.

The failure of W/T-U and W/CL to increase correspondingly, if found to be consistent, would provide added insight into the strategies junior high students use to recode and embed, that is, by creating full clauses rather than by reducing, then embedding, these clauses. Nor would this be inconsistent with published data. Hunt (1970) found that these middle grade students used proportionally more full relative clauses than either younger or older subjects. It should also be noted that any differences between subjects' rewriting of "Aluminum" and "Bee" stimulus passages may be attributed to the fact that the data for constructing the "Aluminum" passages was taken from actual rewrites of the "Aluminum" in kernel form by subjects at the appropriate levels, while the "Bee" passages were based on numberical conversions of the "Aluminum" data and not on actual writing. It would seem then, that despite the remarkable similarities between the results from "Aluminum" and "Bee", there is still some difference.

It is of more than passing interest to note (Table 5) that the rewrites by the subjects in this study of both the "Aluminum" kernel and "Aluminum" eighth grade stimulus passages are almost identical to those of Hunt's eighth graders, and that the ninth graders in this study rewrote the "Aluminum" kernel and eighth grade stimulus passages much as predicted. Their clause length on both passages falls between Hunt's eighth and tenth clause lengths. The T-unit length of these subjects is slightly greater than that of Hunt's tenth graders, but is well within one standard deviation of Hunt's tenth grade mean.

Table 5

Comparison of Hunt's (1970) Eighth and Tenth Grade Data, And Eighth and Ninth Grade Data From the Present Study

	Hunt Grade 8	Smith Grade 8		Smith Grade 9		Hunt Grade 10
		K Input	G8 Input	K Input	G8 Input	
W/T-U	9.84	9.43	10.03	10.94	11.27	10.44
W/CL	6.97	6.76	7.17	6.97	7.06	7.35

Subjects who were rewriting the eighth grade and Skilled Adult stimulus passages would have a definite advantage over subjects rewriting a kernel input passage, simply because they would be starting with more complex material, which may have cued them to a particular embedding strategy. In addition, many subjects were summed together; thus, if some of the subjects rewriting Skilled Adult material had simply copied, the mean complexity of the group would have been increased. Consequently, even though the data indicate complete acceptance of both Hypothesis 2 (Table 4) and Hypothesis 3 (Table 3), and inspection of the rewrites indicates no verbatim copying, further research is required before these results can be regarded as fully meaningful.

The most interesting hypothesis from both the pedagogical and the research point of view was that subjects would decrease complexity when rewriting the Skilled Adult stimulus passages (Hypothesis 7). If this hypothesis were accepted, the combination of the Hunt and Slobin techniques would be considered usable. Unfortunately, the results do not present a clear picture (Table 4). If W/T-U is used as the syntactic measure, the hypothesis is prevented from being accepted by the failure to find a significant change in the ninth graders rewriting of the Skilled Adult "Aluminum" passage. This failure to find significance is due to the abnormally high standard deviation in that cell (4.94). Had that deviation been more like those of the other cells, significance might have been obtained.

However, using the W/CL measure, significance is found in all cells. It appears, then, that the W/T-U and W/CL were changed in an uncorrelated manner, at least by the ninth graders rewriting "Aluminum". These subjects, while not changing the length of the T-units, were shortening clause length. Since the T-unit itself is composed of one or more clauses, the only way to shorten clause length while not decreasing T-unit length is to create new subordinate clauses and some new main clauses. For example, the "Aluminum" Skilled Adult stimulus passage was:

> Aluminum, an abundant metal with many uses, comes from bauxite, an ore which looks like clay. To extract the other substances from the aluminum found in bauxite, the bauxite is ground and is put in pressure tanks. The other substances form a mass which is removed by filters. The remaining liquid is put through several other processes, finally yielding a powdery, white chemical, alumina, which is a mixture of aluminum and oxygen. The oxygen is removed by electricity, producing a light metal with a bright, silvery luster. This metal comes in many forms.

These subjects reduced complexity by rewriting the less-than-clausal embeddings in the Skilled Adult passage as full clauses. For example:

> Aluminum is an abundant metal which has many uses and comes from bauxite which is an ore that looks like clay. Bauxite contains aluminum and several other substances. Aluminum is extracted from bauxite by grinding it, then putting it in pressure tanks where the other substances form a mass which is removed by the use of filters. The liquid which remains is put through several other processes and finally yields a chemical which is powdery and white. The chemical is alumina, a mixture which contains oxygen and aluminum. The aluminum is separated from the oxygen by the use of electricity which produced a metal. This metal is light and has a luster which is bright and silvery, and it comes in many forms.

CONCLUSIONS AND IMPLICATIONS

The data indicate that Hunt's (1970) results may be used to predict subjects' performance when rewriting the "Aluminum" passage, not only from kernels (as Hunt's subjects did) but from other levels of syntactic complexity. This can be considered a replication and affirmation of Hunt's study. Furthermore, the largely parallel performance on the "Bee" passage indicates that Hunt's data may be sufficiently generalizable to allow the generation of new instruments from that data.

When rewriting, subjects increase the complexity of a passage written at a syntactic level below their own, do not appreciable change the syntax of a passage written at their own levels, and decrease the complexity of passages written at higher levels. This is, in essence, what Slobin discovered about oral language. However, the change in the complexity of written material is stronger evidence for the existence of recoding strategies, for the stimulus is not removed as it is when oral language is tested. When the stimulus is removed, any alterations in the response may be due to memory loss or failure to decode, as well as to recoding strategy. If the stimulus is recalled intact, the reason may be memory or recoding strategy. However, when, as in the present experiment, the stimulus is not removed, memory is less likely to be a factor. If the response differs from the stimulus, the reason must be in the recoding.

In general, the ninth grade subjects rewrote the instruments using longer T-units and clauses than did the eighth graders. Since a considerable overlap in student ability is expected in any two such contiguous grades, these consistent, though not statistically significant, differences indicate that the instruments may indeed be sensitive enough for greater use.

Finally, the students in this study seemed to comprehend all that the input passages stated. The fact that they were able to convert less-than-clausal embeddings into full clauses retaining the same content implies that, while they may not produce syntactic

structures at the Skilled Adult level, these junior high students could comprehend writing at that level. This does not imply that they would read more complex or less complex material as well as they might read that material written at their own level of complexity. On the contrary, it implies that when reading material written at some level other than their own, they must utilize some recoding strategy to alter that material.

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