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ABSTRACT

Thirty-one third-grade students participated in an investigation of the possibility of training or improving intrasentence organizational skills in the context of a sentence anagram task. Sentence-anagram organizational training was conducted on an individual basis with the 16 students in the experimental group. A sentence-anagram posttest was used to measure the effects of training. Results for both the number correct and the number of seconds per item favored the experimental group and the above average readers. Effects of sentence training on reading comprehension were assessed using posttest results of four reading comprehension tests. Results from multivariate analysis of variance showed significant differences favoring the experimental group and the above average readers. Results from a follow-the-dots test, given as a pretest and a posttest to assess the effects of novelty on group performance, showed no significant differences between experimental and control or between average and above average readers. The results were interpreted as supporting the usefulness of the sentence-anagram task and the word-grouping strategy underlying it for training in organizational skills and for improving reading comprehension. (AA)

Component Skills in Reading Comprehension: An Investigation of the Effect of Sentence Organization Instruction

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Background and Statement of the Problem

Since the early 1900's, there has been more research in reading than in any other curricular area (Russell & Fea, 1965). Most of this research has concentrated on the beginning stages of reading skill development and has focused primarily on word recognition. Far fewer studies have been concerned with skills of comprehending printed material. Recently, however, the need for additional research and better instructional practice in reading comprehension has begun to be recognized. There has been a call for investigation of the cognitive processes involved in comprehending printed language and the instructional strategies that facilitate the development of these processes (Miller, 1973). Gibson, Tenney, and Sharabany (1971), for example, suggested the need for a change of research emphasis from decoding processes to the more complex processes that determine whether the reader is getting information from the printed message. And Carroll (1970) pointed to a need for research to determine the detailed psychological processes by which skilled readers comprehend the simple meaning of what they read and to determine the way lexico-semantic, syntactical, and typographical factors interact to yield this comprehension.

In addition to the call for research in reading comprehension, there has been a growing dissatisfaction among parents and educators with what is loosely called "reading comprehension instruction." What generally constitutes reading comprehension instruction in the elementary grades is repeated practice in reading passages and answering various types of questions related to the passages. This kind of activity gives students an opportunity to demonstrate whether they have comprehended what they have read, but it does not provide them with strategies for encoding and processing the text while they are reading it. Moreover, if students do not demonstrate adequate comprehen-

sion, the typical procedure is to give them more practice in reading passages and answering questions. It is unlikely, however, that reading comprehension will improve with practice unless explicit instruction is provided first. Therefore, what is needed is carefully sequenced instruction designed to train, and then to provide practice in, those subskills shown to be related to reading comprehension.

In response to this perceived need for additional research and better instructional practice in reading comprehension, the study reported here focused on selected processes and skills thought to be related to reading comprehension. An instructional program to train these skills was developed and implemented with a group of third graders, and the effects of training on reading comprehension performance were assessed.

Theoretical Framework and Purposes of the Study

Better understanding of reading comprehension is dependent on the explication of its component processes and skills and the nature of their interrelationships. Certain processes and skills (e.g., decoding and vocabulary) have been shown experimentally to be necessary for reading comprehension to occur. The nature of other processes and skills (e.g., syntax or intra-sentence organization) and their relationship to comprehension need further investigation.

It is widely recognized that accurate and rapid decoding of printed symbols into language is closely related to reading comprehension (Carroll, 1970; Chall, 1967; LaBerge & Samuels, 1974; Perfetti & Hogaboam, 1975). Some theorists even consider comprehension to result from accurate decoding (Bloomfield, 1942; Fries, 1963). This extreme position appears untenable; researchers and classroom teachers have reported the existence of students

who decode fluently but do not grasp the meaning of the message (Cromer, 1970; Oakan, Wiener, & Cromer, 1971). Thus, although decoding skills are necessary, even prerequisite, they do not guarantee comprehension of printed language.

Knowledge of word meanings is also considered a necessary component of the reading comprehension process. The importance of vocabulary skills is supported by results of the factor-analytic research of Conant (1942), Davis (1968), and Langsam (1941). But sentence meaning is not simply the sum of the meanings of individual words, and the meanings of words often vary with the contexts in which they are used. Thus, word knowledge, although necessary, is not sufficient for comprehension to occur.

The encoding of verbal information as meaningful units larger than the single word appears to be necessary to obtain the meaning of combinations of words (Cromer, 1970). The formation of these meaningful units appears dependent in large part on knowledge of syntax or the structural relationships among words in sentences (Denner, 1970; Resnick, 1970; Ruddell, 1969). Findings such as these suggest that certain intra-sentence organizational processes and skills are an important component of reading comprehension. Furthermore, although several authors suggest the need for specific syntactic or organizational training to enhance reading comprehension (Bormuth et al., 1970; Denner, 1970; Gibbons, 1941; Resnick, 1970), a review of the literature revealed no systematic attempt to train these skills and to measure their effects on reading comprehension.

The sentence anagram task, a word-grouping strategy, and a training procedure were developed to train intra-sentence organizational skills. The sentence anagram task involved rearranging a scrambled set of words (from

5 to 15 words long) to form a single sentence. The sentence anagram task appears to be a suitable task through which to train intra-sentence organizational skills because sentence anagram performance correlates positively with reading comprehension test scores (Gibbons, 1941) and because sentence anagram solution is facilitated when words are prearranged in phrases (Oléron, 1961). Results of pilot testing indicated that organizing words into phrases and clauses appears to be necessary for solution of long sentence anagrams. That is, short (5-7 words) sentence anagrams can be solved in brief periods of time without first organizing the words into groups; but attempts to solve longer (10-15 words) sentence anagrams in relatively brief time periods appear to "overload" short-term memory, unless the words are first grouped into phrases or clauses. Thus, it was speculated that if organizational skills were trainable, then systematic sentence anagram organizational training would facilitate sentence anagram solution. Further, insofar as improved sentence anagram performance reflects an improvement in general organizational skills, this improvement was expected to be reflected in the quality of reading comprehension.

The word-grouping strategy, developed for this study, was based on the Lindsay-Norman model of human memory (1972) and Fillmore's case grammar (1968). The strategy was designed to induce students to solve sentence anagrams by arranging words systematically into phrases and clauses and ordering these units to form a sentence. The students were taught to form word groups by identifying the verb and asking a series of questions to group the remaining words and to determine how the word groups are related to the verb. Thus, the training procedure involved instruction in and practice on the use of the word-grouping strategy to solve sentence anagrams of

increasing length in relatively less time. (See the Appendix for a model of the word-grouping strategy and for a description of the training procedures.)

Given these considerations, the purposes of this study were (a) to investigate the possibility of training or improving intra-sentence organizational skills (in the context of the sentence anagram task), and (b) to explore the effects that training had on reading comprehension. Because comprehending written text is assumed to depend on many subskills, rather than on a single skill, and because tests of reading comprehension typically require demonstration of more than one subskill, four different reading comprehension tests were used to measure the transfer effects of intra-sentence organizational training. It was further proposed that training would have transfer effects that differed according to the relationship between the requirements of the training task and the requirements of the different reading comprehension tests. Thus, a third purpose of this study was to explicate the differential effects training had on performance on different types of reading comprehension tests. The four tests used were: a timed sentence recognition test that measured the speed with which students could distinguish meaningful sentences from nonsense and false sentences; a cloze test that measured the accuracy with which students could reconstruct a meaningful story from text that had every fifth word deleted; a prompted verbatim recall test that measured the accuracy with which students could reproduce or paraphrase sets of sentences; and a passage-question test that measured the accuracy with which students could respond to multiple-choice, literal and inferential comprehension questions based on a passage when the passage was available for reference.

Main Hypotheses and Methodology

A two-factor randomized block design was used: two treatments (Experimental and Control) by two levels of reading ability (Average and Above Average). The data were analyzed in relation to the questions posed by the study. The first three questions asked (a) whether experimental and control students and (b) average and above average readers differed significantly in their performance on the sentence anagram posttest, and (c) whether there was a significant treatment by reading level interaction. Scores from the sentence anagram test were analyzed using two-way analysis of variance (Treatment X Reading Level).

The next three questions asked (a) whether experimental and control students and (b) average and above average readers differed significantly in their performance on four tests of reading comprehension, and (c) whether there was a significant treatment by reading level interaction. Test scores from the reading comprehension tests were analyzed simultaneously using two-way multivariate analysis of variance (Treatment X Reading Level).

The last question asked whether the effects of sentence anagram organizational training were reflected differentially on the four tests of reading comprehension for experimental and control students, and for average and above average readers. This question was answered by using discriminant analysis and univariate analysis of variance.

Subjects

The subjects in this study were 31 third graders attending a public school in a middle class suburban area near Pittsburgh, Pennsylvania. The experimental and control groups were equated for reading level (determined by reading grade equivalent scores) and for sex. Average readers were the 15

students whose reading grade equivalent scores were less than one year above the expected score (3.8) at the time of testing. Scores ranged from 2.1 to 3.6 (M = 2.82; SD = .57). Above average readers were the remaining 16 students whose reading grade equivalent scores were one year or more above the expected score (3.8) at the time of testing. These scores ranged from 3.8 to 5.8 (M = 4.45; SD = .60). The average and above average readers were divided according to sex and assigned randomly and equally to treatment groups.

Sentence anagram organizational training was conducted with the 16 students in the experimental group on an individual basis. Each student was seen for approximately 15 minutes, two or three times a week and no session took place during formal reading instruction. Control students remained in their classrooms and did not receive any training. Each experimental student was placed in the training program according to his or her sentence anagram pretest performance. For each student, training began with sentence anagrams that were the length of the longest correctly solved pretest item, where all previous items were solved correctly. Training continued for each student until he or she could solve sentence anagrams (within specified time limits) that were five words longer than those solved on the pretest. The mean number of sessions needed for the above average readers to complete the training program was 15.75 (ranging from 14 to 19); average readers required a mean of 18.12 sessions (ranging from 15 to 21). Students could generally complete between 6 and 10 sentence anagrams in a session.

Results

Results of Sentence Anagram Training

The effects of sentence anagram training were assessed using the results

of the sentence anagram posttest. The two dependent measures analyzed were the total number correct, and the average number of seconds per item required to solve eight sentence anagrams, four that were five words long and four that were six words long. The possible range of scores was 0 to 26. The method of analysis used was 2 X 2 (Treatment X Reading Level) analysis of variance for each of the dependent variables.

The posttest analysis of variance for the number correct on the sentence anagram test yields highly significant differences between experimental and control groups, F (1, 27) = 22.56, $p < .0001$, and between average and above average readers, F (1, 27) = 41.55, $p < .0001$. These results favor the experimental students and the above average readers. The interaction between treatment group and reading level is not significant.

The analysis of variance for the average number of seconds per item shows moderately significant differences between experimental and control groups, F (1, 27) = 5.77, $p < .02$, and highly significant differences between average and above average readers, F (1, 27) = 16.12, $p < .0005$. These results favor the experimental students and the above average readers. The interaction between treatment group and reading level is not significant.

Effects of sentence anagram training on reading comprehension were assessed using the posttest results of four reading comprehension tests. The four dependent measures and their possible ranges were the number of seconds required to complete the timed sentence recognition test (0-26) and the numbers correct on the cloze test (0-55), the prompted verbatim recall test (0-20), and the passage-question comprehension test (0-45). The method of analysis used was a 2 X 2 (Treatment X Reading Level) multivariate analysis of variance on the dependent variables tested simultaneously.

Multivariate analysis of variance on the four dependent measures indicates significant differences between experimental and control groups, F (4, 24) = 6.21, p < .0015. The difference between average and above average readers is also significant, F (4, 24) = 6.31, p < .001. These differences favor the experimental group and the above average readers. The interaction between treatment group and reading level is not significant.

Discriminant analysis reveals which particular tests account for the differences suggested by the results of the multivariate analysis. The results of univariate analysis of variance for each variable aid in the interpretation of the multivariate and discriminant analysis.

The results of the discriminant and univariate analyses on the four reading comprehension tests indicate that the loci of the difference between experimental and control groups appears to be centered in the cloze test, F (1, 27) = 6.65, p < .016, discriminant function coefficient (dfc) = -.57, and in the prompted verbatim recall test, F (1, 27) = 16.90, p < .0004, dfc = .77. The timed sentence recognition test, F (1, 27) = 2.56, p < .12, dfc = .43, and the passage-question test, F (1, 27) = .005, p < .94, dfc = .39, contribute some "weight" in discriminating between groups, but the pattern of univariate F-ratios indicates that the contribution is not significant.

Reading level centroids, those comparing average and above average readers, indicate that the cloze test, F (1, 27) = 19.71, p < .0002, dfc = -.59, and the passage-question test, F (1, 27) = 20.01, p < .0002, dfc = -.57, are important discriminators between reading levels. Although differences were not reflected on the discriminant analysis, the univariate F-ratio and its associated probability level for the timed sentence recognition test, F (1, 27) = 4.50, p < .03, dfc = .05 indicate that this test also contributes

to reading level differences. The prompted verbatim recall test does not discriminate between average and above average readers, F (1, 27) = .006, $p < .94$, dfc = -.04.

Results of the Follow-the-Dots Test

The results of this study suggest that intra-sentence organizational training improved performance on the sentence anagram task and that these effects transferred to and improved performance on certain reading comprehension tests. It might be argued, in the absence of control group intervention, that these improvements were the result of special attention from the experimenter and the novelty of the experimental situation, instead of the result of training.

A follow-the-dots test was given to all students before and after sentence anagram training to help support the contention that posttest results reflect effects of training rather than effects of the experimenter and/or experimental novelty. The follow-the-dots test is very different from the sentence anagram task, so it was highly unlikely that training would improve follow-the-dots performance. But, performance of experimental students might improve on it if, for example, they tried harder in an attempt to please the experimenter. Thus, it was reasoned that if experimental students generally outperformed control students on posttests, including the follow-the-dots test, results would have to be interpreted cautiously in light of possible experimenter and experimental novelty effects. If, on the other hand, experimental students outperformed control students on other posttests but were not significantly different on the follow-the-dots test, then results would more likely be attributable to the effects of sentence anagram training. The dependent measure analyzed was the total number of patterns completed correctly

in 10 minutes. The possible range of scores was 0 to 23. The method of analysis used was a two-way analysis of variance (Treatment X Reading Level).

The results of the pretest analysis indicate no difference between experimental and control groups, F (1, 27) = .84, $p < .37$, or between average and above average readers, F (1, 27) = .29, $p < .59$. The interaction between treatment group and reading level is not significant. The posttest results are similarly not significant. The analysis of variance reveals no significant differences between experimental and control groups, F (1, 27) = .003, $p < .96$, or between average and above average readers, F (1, 27) = .82, $p < .38$. The interaction between treatment group and reading level is also not significant.

Results of this study strongly support the value of sentence anagram training. Experimental students significantly outperformed control students on the sentence anagram test, the prompted verbatim recall test, and the cloze test. In contrast, there were no significant treatment group differences on either the follow-the-dots pretest or posttest. These results do not rule out the possibility that there were some experimenter and experimental novelty effects--some percentage of the experimental group's superiority may be attributable to these effects. However, they do suggest that experimental group gains are due, in large part, to the effectiveness of sentence anagram training. The inclusion of an expected "zero transfer" test, such as the follow-the-dots test, is useful in situations where control group intervention is impractical or impossible. This type of test can aid in the interpretation of results, but it should not be considered an equal substitute for control group intervention.

Discussion

The results of this investigation indicate that students who received sentence anagram training were significantly more accurate and faster on the sentence anagram test than were students who did not receive training. Results of the sentence anagram posttest and observations made during sentence anagram training are strong evidence that organizational skills can be developed and improved by training students to use the word-grouping strategy to solve sentence anagrams and by giving them ample practice with feedback. That is, students can be taught to group words systematically into meaningful units larger than the single word.

Further, the results of this investigation indicate that when reading comprehension was measured by combining the four tests, students who received sentence anagram training performed significantly better than students who did not. These results suggest that improving organizational skills in one context generalizes to and improves reading comprehension, as measured by a combination of different reading comprehension tests.

It was suggested that effects of sentence anagram training would be reflected differently on the tests of reading comprehension because of differences between skills measured by each test and the skills emphasized during training. The results of the discriminant and univariate analyses indicate that for experimental and control students, effects of sentence anagram training transferred most to the prompted verbatim recall test and next to the cloze test. Effects of training transferred less to performance on the timed sentence recognition test and least on the passage-question test. During training, students were taught to "chunk" words into phrases and clauses and to use syntactic cues to form these units. Demonstration of these skills was required on the prompted verbatim recall test and the cloze test, respectively. These results support the view that reading comprehension depends on many skills

and demonstrate the value of explicit instruction and practice on the component processes and skills required for comprehension of text.

Instructional Implications

Some important instructional implications can be drawn from the results of this study. First, the results support the value of instruction explicitly designed to improve reading comprehension and suggest that in addition to instruction and practice in decoding and vocabulary development, instruction in other skills enhances the quality of reading comprehension. The task used and the procedures followed in this study demonstrate that intra-sentence organizational skills can be trained and therefore merit specific instruction in the classroom.

The sentence anagram task is particularly suitable for the purpose of training intra-sentence organizational skills. First, the task provides a vehicle for training and practice on the use of the word-grouping strategy. Second, solving sentence anagrams is in itself evidence of sentence comprehension, and it therefore provides an opportunity for students to demonstrate comprehension. Finally, the task is fun--it has game-like qualities, and students enjoy "playing" it. These game-like qualities, a motor component (manipulating cards) and a competitive component (increasing sentence length and speed), are highly motivating and thus increase the likelihood that organizational skills will improve.

Generally, the results of this study imply that the classroom teacher would do well to apply (theoretical) principles of learning and instruction to all skills taught in the classroom. Specifically, this study offers the classroom teacher a systematic procedure for training organizational skills and improving reading comprehension. These results were achieved after a total of about 3 1/2 hours training with each student. Spending this amount of time with each student is not feasible in a traditional classroom, but the training procedure is probably adaptable to group- and peer-instruction. It is also

conceivable that the training procedure could be modified and take the form of a "learning center" activity where students could work independently. A third instructional implication can be drawn from the fact that training one set of reading comprehension subskills improved performance on certain reading comprehension tests. Specifically, word-grouping training on the sentence anagram task improved performance on the cloze test and on the prompted verbatim recall test. The cloze requires students to follow the detailed ideas and grammatical patterns that are contained within sentences and among closely adjacent groups of sentences. Apparently, the word-grouping strategy enabled students to attend to structural relationships among words in sentences. This attention to syntax transferred to, and resulted in improved performance on the cloze comprehension test. The prompted verbatim recall test measures short-term recall for groups of sentences. Because short-term recall improves as the size of the "processing" unit increases, improved performance on the prompted verbatim recall test implies an increase in the size of the unit. Presumably, the word-grouping strategy affected a general increase in the size of the "chunk" by which information is encoded and processed; this, in turn, resulted in improved performance on the prompted verbatim recall test. These results imply that certain skills have high transfer value, that is, they can be trained in one context and will generalize to certain other contexts. This suggests that identifying and training these apparently more general skills may be more efficient than providing training for every set of skills that students are expected to master.

Future Research

Several directions for research are suggested by the findings of the present study. In general, this study needs to be extended to different samples of students. For example, an extension comparing training effects

across different age groups could be productive in tracing the acquisition and development of the organizational skills taught in this study. In addition, the average readers in this study were no more than one year below their average expected reading level. Further exploration is needed to determine whether a certain level of decoding competence is prerequisite to improving organizational skills, or whether training in both skills can be concomitant.

The sentences used in the training and testing procedures were all in the active voice. It would be interesting to investigate whether the sentence anagram task and a modified version of the word-grouping strategy could be used, for example, to familiarize young students with the passive construction. It would also be of interest to trace the spontaneous development of solution strategies, those that develop in the absence of direct instruction. Such investigation could provide useful information regarding the development of organizational and problem-solving skills.

Finally, an extension of this study that includes control group intervention is needed. In addition to controlling for experimenter effects, different control treatments could be compared with sentence anagram training to determine the most effective and efficient method for training organizational skills and improving reading comprehension.

In summary, the results of this research support the usefulness, for the elementary classroom teacher, of the sentence anagram task and the word-grouping strategy for training organizational skills and improving reading comprehension. In addition, these results support the findings of certain psychological and psycholinguistic research and suggest several potentially useful directions for future research.

APPENDIX

Word-Grouping Strategy and Sentence Anagram Training

The word grouping strategy was designed to induce students to arrange words systematically into phrases and clauses, and then to arrange the phrases and clauses into sentences. The students were taught to form word groups by first identifying the "action word," or verb, and then asking a series of questions to group the remaining words and to determine how the word groups are related to the verb.

Theoretical support for the notion of forming a word group with the verb functioning as the pivot came from a model of human memory proposed by Lindsay and Norman (1972). According to their model, events are encoded in memory by first ignoring the details and identifying the "action," or verb of the sentence. The next steps are to find the "agents," the "objects," and the "recipients." The Lindsay-Norman model is based, in part, on the case grammar proposed by Fillmore (1968).

Figure 1 shows the general structure of the word-grouping strategy devised to capture the centrality, or pivotal function, of the verb. The model is capable of constructing five- to fifteen-word declarative sentences in the active voice. The actions (rectangles) and decisions (diamonds) are those thought to be involved in skillful performance of the sentence anagram task. The model assumes knowledge of the concepts "action word," "WH question," syntactic and semantic "sensibility," and "complete sentence." The box at the bottom left of Figure 1 presents an order, heuristic in nature, in which to ask the WH questions.

The actions and decisions depicted in the model formed the basis for sentence anagram organizational training. Students were taught how to perform the actions shown in the rectangles and how to monitor their actions by asking and answering the questions depicted in the diamonds. The use of the word-grouping strategy to solve a sample sentence anagram was demonstrated by

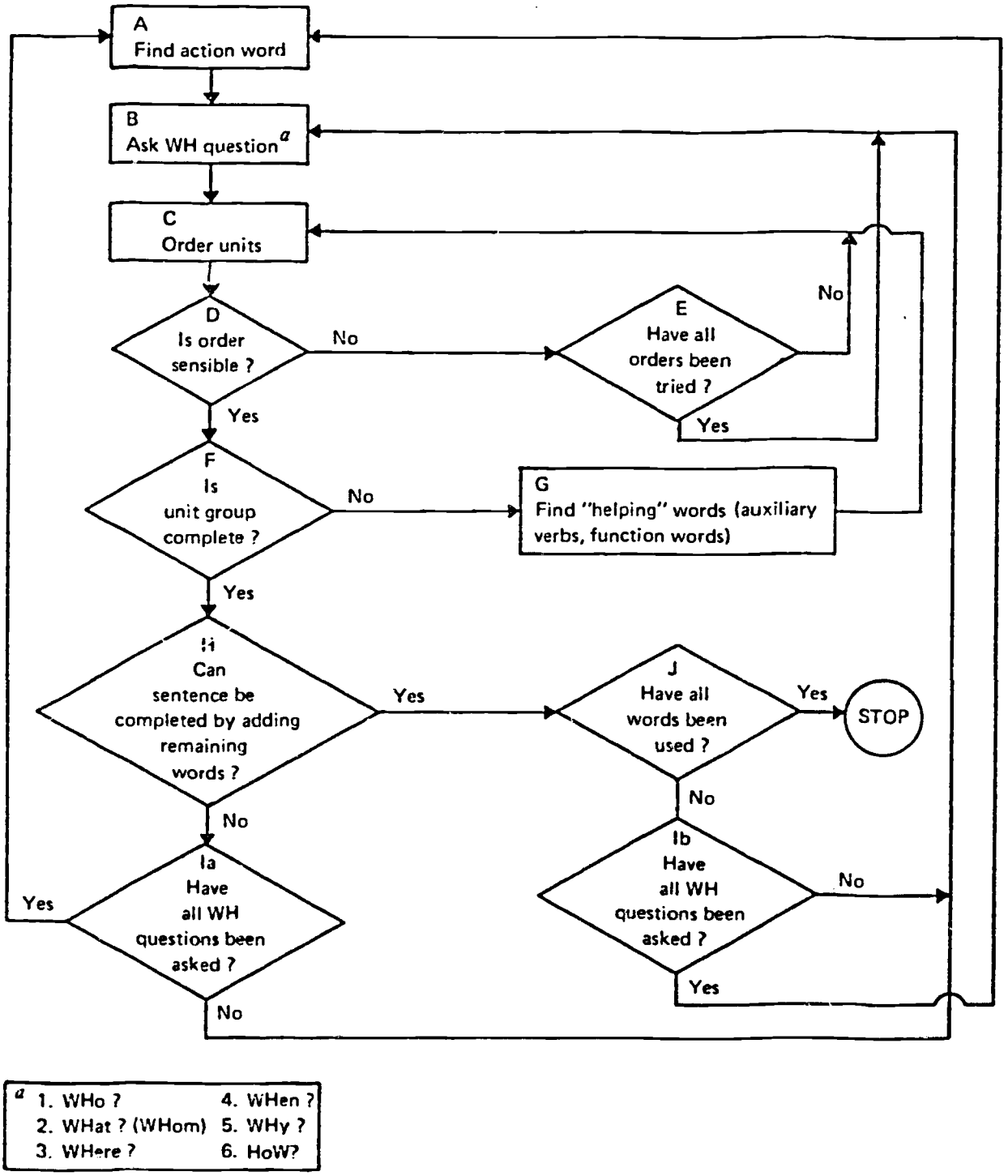

Figure 1. Model of sentence anagram word-grouping strategy for declarative sentences in the active voice.

the experimenter. A simplified version of the word-grouping strategy was presented to establish the steps of the strategy and the order in which they were to be executed. Each action and decision (including examples of how to resolve incorrect decisions) was verbalized by the experimenter to demonstrate the type of behavior in which the student should engage. Next, the student was asked to imitate the experimenter, who, in turn, encouraged the student to refer to the printed table and otherwise prompted the student whenever necessary. Because the training program was individualized, the amount and type of explicit instruction varied from student to student. In addition to training in the use of the word-grouping strategy, all children were exposed to the following training procedures and activities:

1. The concepts of verb and action word, WH question, sensibility, and complete sentence were taught to each student.

2. Once a student was solving sentence anagrams of any given length by using the word-grouping strategy, a time element was introduced. Students were encouraged to decrease the time needed to solve the sentence anagrams. Time was recorded and students were informed of their progress. These data were used to determine when to introduce longer sentences.

3. Once students were able to solve sentence anagrams of any given length, at least 80% of the time within the time limits set by the pretest, sentence anagrams one word longer were introduced.

4. Vocabulary level and sentence structure of the sentence anagrams were the same for all students. The vocabulary was no higher than second-grade level, and the sentences were declarative and in the active voice.

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