SHORT-TERM MEMORY AND IMITATION: EFFECTS OF SENTENCE LENGTH, SENTENCE TYPE, WORD TYPE, STRESS, AND GRADE

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ABSTRACT

SHORT-TERM MEMORY AND IMITATION: EFFECTS OF SENTENCE LENGTH, SENTENCE TYPE, WORD TYPE, STRESS, AND GRADE

By

Annette Smith

A review of the literature suggested the need for further analytical work in the area of language learning. Previous research, in an effort to be descriptive about a particular variable under study, had failed to consider the interaction of the variables involved and, further, failed to adequately experimentally control extraneous variables.

The purpose of this study was to investigate the responses of first, third, and fifth grade children to a sentence imitation task involving simultaneously the factors of sequence length, sentence type, word type, and stress.upon a sentence repetition task.

Ninety first, third, and fifth grade children from an elementary school in southern Michigan served as subjects. All had normal speech, language, and hearing as assessed from the school screening records. Fifty-four sentences were presented via a tape recorder in a sound

field to each of the subjects. The four factors of sentence length, sentence type, word type, and stress were completely counter-balanced and then randomized for the presentation. All ninety subjects received three-, five-, and seven-word sentences of ill-ordered, anomalous, and well-formed construction for two conditions of stress (stress and unstress) falling on both contentive and functor word types. Using standardized instructions subjects were asked to repeat exactly what they heard on the tape.

Errors were scored on a mean per cent error basis. Any words deleted or substituted were considered an error.

The results of this study indicated that sentence length, sentence type, word type, stress, and the grade level of the child did interact at various levels. Therefore, the main effects depicted by a separate analysis of the variables became incomplete as a description of what cues may be used for language encoding and performance. The results showed that as length increased, error rate increased. Further, ill-ordered sequences had greater error rates than anomalous and well-formed types, respectively. The effect for word type indicated that more errors occurred on functor word types than on contentive word types. The effect for stress indicated that unstressed words had greater error rates than stressed words. Finally, error rate decreased as grade level increased.

Two major interactions occurred between sentence length and sentence type and between stress and word type.

Ill-ordered sequences had higher error rates at all lengths than any other length-type combinations. The differences between stressed and unstressed error rates were greater than the differences between functor and contentive error rates. This indicated that the use of stress as a differential cue in retention of words was correctly utilized more often than were word type cues.

The results of this study, as depicted by the subjects' differential retention of words in this sentence imitation task, indicated that sentence length, sentence type, word type, stress, and grade level of the child did interact at various levels. This study also suggested that future research be conducted in order to further substantiate the trends and investigate the interactions.

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CHAPTER I

INTRODUCTION

There has been increasing interest in recent years in determining how children acquire and utilize various aspects of language behavior. One method often used in such investigations involves repetition tasks. Further, recent theoretical considerations require that such tasks and resultant behavior be related to memory storage systems for language.

Short-Term Memory

Several theoretical descriptions and models of short-term memory are available in the literature (Aaronson, 1967; Broadbent, 1957; Pollack, 1959; Sperling, 1963). Most of these models view memory as at least a two-stage process. Table 1 lists several terms associated with models of memory. Figure 1 depicts a composite view of these several models for purposes of the present investigation. The first stage is characterized by a large capacity, parallel processing system whereby more than one stimulus item can be dealt with simultaneously; however, the stimuli decays, i.e., is forgotten rapidly in Stage I. Stage II, at

TABLE 1.--Terms and Sources Used to Describe the Processing Systems for Memory.

Short-Term Memory - Names and Characteristics
1. Stage I (Aaronson, 1967)
2. Sensory System (Broadbent, 1957)
3. Performance (Chomsky and Halle, 1968)
4. Primary Memory (Aaronson, 1967)
5. Automatic (Kirk, 1968)
6. Large Capacity (Aaronson, 1967)
7. Rapid Decay (Aaronson, 1967)
8. Parallel System (Aaronson, 1967)
Long-Term Memory - Names and Characteristics
1. Stage II (Aaronson, 1967)
2. Perceptual System (Broadbent, 1957)
3. Competence (Chomsky and Halle, 1968)
4. Secondary Memory (Aaronson, 1967)
5. Representational (Kirk, 1968)
6. Small Capacity (Aaronson, 1967)
7. Slow Decay (Aaronson, 1967)
8. Single Channel (Aaronson, 1967)

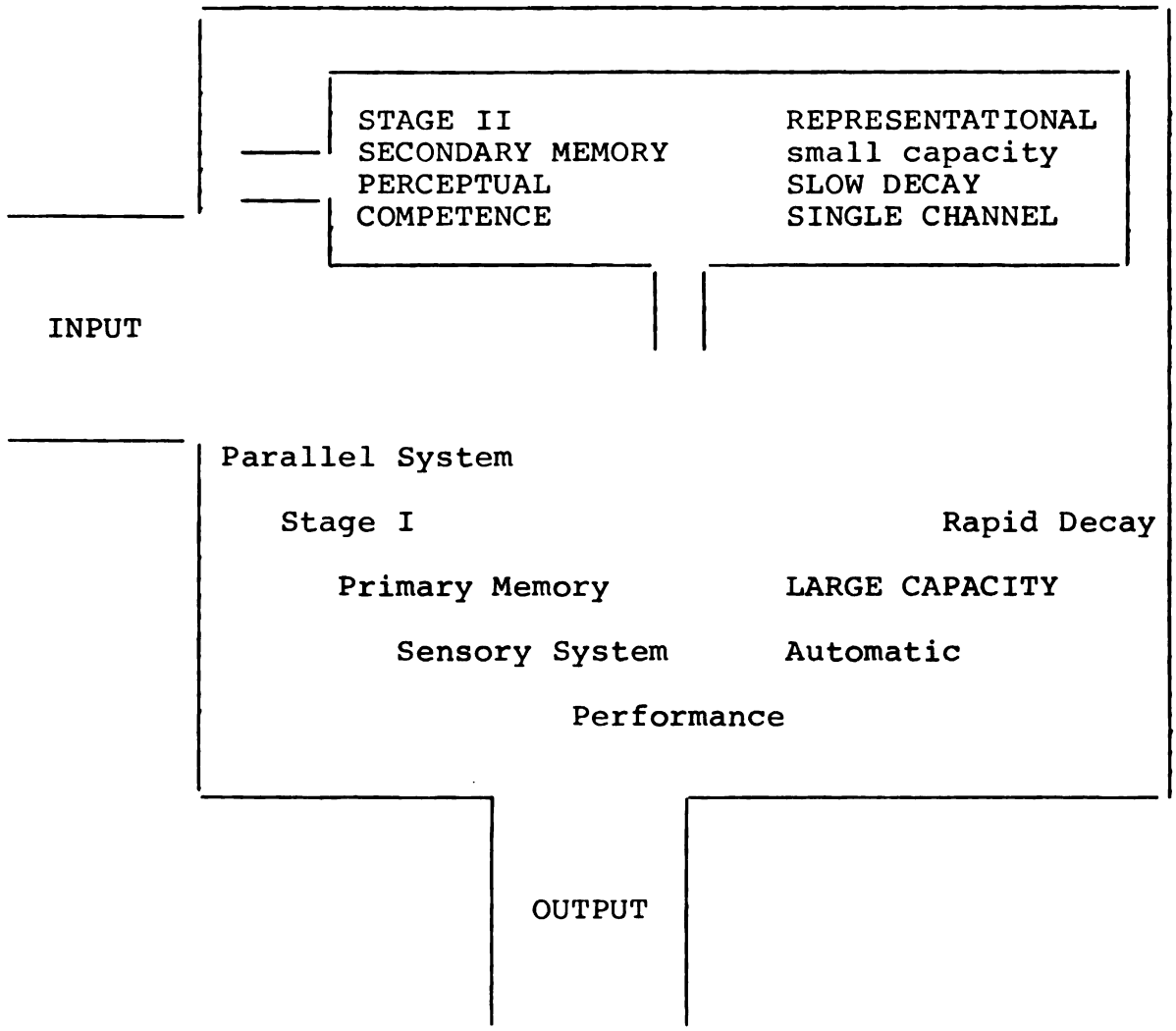


FIGURE 1.--Memory Model Employing Various Concepts Associated with Memory Systems.

least in the model used for this study, is characterized by a single channel entrance to a small capacity but slower decaying processor. While Stage I may be most closely related to performance, Stage II is most likely related to competence as defined by Chomsky and Halle (1968).

Studies described in the following section have been involved in investigating specific aspects of language acquisition. It is important that if any conclusions are drawn from the results of such studies, that consideration be given to the relationship of memory storage, particularly short-term memory. It seems reasonable to postulate that various aspects of language behavior be reflective of short-term memory performance, particularly on relatively simple repetition tasks. That is, behaviors associated with language and perception may be developmentally bound, and such developmental behavior may very well be related to performance characteristics of short-term memory. Thus, as the child matures, the burden upon memory processes becomes less difficult as a result of the child's increasing ability to handle several characteristics of language simultaneously. Because of its relative simplicity, a repetition task serves as a very useful method for investigating these processes in children.

Repetition Tasks

Brown and Bellugi (1964) found that children seem to respond to repetition in their original learning of

language. Often, the child's imitation is a reduction of the model utterance. According to Brown and Bellugi, this reduction is usually expanded again by the mother (the model). In spite of the model's expansion or the length of the utterance, the child would repeat only two to four morphemes which Brown and Bellugi noted as characteristic of this age (eighteen to thirty-six months). It would therefore seem reasonable that some type of repetition task might be used to analyze which characteristics of speech input (i.e., stimuli) serve as cues to the child when he is learning to produce language. There is, however, a problem with such study. It is possible that children would repeat a string of words or a sentence without actually having processed the stimuli through the secondary processing system. (See Figure 1.) If this should occur, then the results obtained from a repetition task may not reflect secondary memory language skills (or, moreover, application of language rules, i.e., competence), but may merely be a reflection of short-term memory, or, as noted by Schuckers (1971), a "parroting" effect. Such repetition tasks not controlling for short-term memory effects may not yield any differentiating information about the higher processes of language learning. It is therefore necessary to control in some way for the child's short-term memory capacity.

One possible control is to use a variety of sequence compositions such as well-formed, ill-ordered, and anomalous

sentential strings (Martin, 1968; Scholes, 1970). A well-formed sentence is characterized by a semantically and syntactically correct utterance. An anomalous sequence approaches a sentence because it is syntactically correct but its meaning has been destroyed. An ill-ordered sequence is neither syntactically nor semantically correct, but all the words necessary for a well-formed sentence are present. (See Appendix A.) If a child cannot repeat a five-word ill-ordered sequence without omissions (i.e., carrot the bunny eats the), then perhaps it can be assumed, at least to a first approximation, that his memory span has been exceeded.

According to Menyuk (1963), a child does not easily produce or reproduce a non-sentence. (Menyuk's example of a non-sentence is one which is ill-ordered.) Omissions of words from such a sequence may indicate that the limits of short-term memory have been reached (Miller, 1956). When these short-term memory limits have been defined for an individual (through an ill-ordered sequence repetition task), then the attempted repetition of either well-formed or anomalous sequences (of the same length or longer than the ill-ordered variety) may be analyzed in terms of reflecting higher, secondary memory processes. Thus, on the most difficult ill-ordered sequence of a reptition task, the memory system's limit can be defined as that ill-ordered sequence length at which words are omitted from the string.

If the individual's immediate memory span has not been exceeded, then there is a possibility that the imitative response is simply a mimic.

Anomalous sentence types have been included in imitation tasks and are included in the present study for purposes of comparing the results of this study with previous studies. Anomalous sequences may also yield information about imitation task processing. If error rate on anomalous sequences approaches that of well-formed sentences, then perhaps syntactic structure is as important to selective retention ability as is semantic form.

Another possible way of controlling for short-term memory parroting effects would be to insert pause time between the words of the stimuli (Schuckers, 1971). The longer time might allow for each word to enter the single channel system (long-term memory) and be utilized for perceptual and, subsequently, encoded processing, thus reflecting upon language competence. (See Figure 2.) The problem with this approach is that it is undoubtedly unrealistic to normal language acquisition patterns. Further, the results of such a task may not lead to information concerning what is stored and how it is stored, since according to the model, the stimuli could either be stored or could decay depending upon the subject's processing strategies (such as rehearsal) and/or the amount of pause time inserted between the words. Further, the prosody

(those elements of stress, accent, and inflection which accompany the human voice) of the sentential sequences would be distorted (Schuckers, 1971). This distortion results from the methodical pause time which destroys elements of coarticulation and meaning or emphasis which may be communicated through a particular phrasing pattern.

Stressing in Sentence Imitation Tasks

Brown and Bellugi (1964) suggested that the element of stress may be an important factor in children's acquisition of language. This observation was made when they were transcribing tapes of mother-child conversations. The words that the mother said which they could hear most clearly were usually the words that the child reproduced. They had trouble hearing the mother's "weakly stressed functors" (p. 139)(inflections, auxiliary verbs, articles, prepositions, and conjunctives) and "the child usually failed to reproduce them" (p. 139). If indeed as Brown and Bellugi suggest, "English is a well-designed language that places heavier stress . . . on concentives" (p. 139) (nouns, verbs, and adjectives), then stress is another factor which must be controlled in language acquisition studies.

Blasdell and Jensen (1970) studied the effects of stress and word-position on thirty- to thirty-six-month-old children. Each string presented to the children for repetition consisted of four nonsense syllables which had

one word receiving primary stress, another intermediate stress, and the third and fourth being least intense, as measured acoustically and perceptually. Perceptual judgments were made by five untrained listeners. There was 100 per cent agreement on the primary stress items and 96 per cent agreement on the intermediate stress items. Blasdell and Jensen found that the subjects imitated the syllables with primary stress and those syllables that occurred in the final position of the string significantly more often than the other syllables.

Scholes (1970) investigated the strategy used by children in their differential retention and deletion of items during a verbal imitation task. His subjects consisted of eleven children from three years, one month to four years, six months. He presented sentential strings of three, four, and five words in length. The length factor was covaried with a sentence-form factor involving well-formed, ill-ordered, and anomolous strings. He did not report the results of length effect upon retention. However, he did find that deletion of content words by the children was unaffected by the sentence form (well-formed, ill-ordered, or anomalous). He also found that functors were deleted more often from well-formed sentences than from anomalous or ill-ordered types. He indicated that all the sentential strings in the experiment were made from

citation form readings, which he concluded as resulting in non-differential word-stress. He concluded that stressing could not be the reason for retention of contentives because no stressing occurred. However, such a conclusion is unwarranted since he reported no analysis to support the contention that stressing did not occur. Also, it is dangerous to conclude that because a factor is not studied, its effect upon the experiment is minimal. His results do not permit the reader to observe whether or not the short-term memory span of the children involved had been exceeded, and if so, at what point this might have occurred. Because he also used nonsense words with real contentives and functors, it would seem that a three-year-old might only recognize contentives, which would account for higher retention of such words.

Beasley and Acker (1971) used a repetition task with four- and five-year-old children. Sentential sequences were either well-formed, ill-ordered, or anomalous, and the lengths of the sequences were three, five, and seven words. Real words were used in all sequences. In some sequences the functor was stressed and in other sequences the contentive was stressed. No significant differences in the number of words deleted were found for the three sequence types of the three-word length. This would indicate the possibility of a parroting effect in operation for this sequence length (Schuckers, 1971). However, in five and

seven word sequences, the ill-ordered sentences had more words deleted than did the anomalous and well-formed sequences. Unstressed functors were deleted more often than stressed functors and unstressed contentives were deleted more often than stressed contentives. The difference was not as great between stressed and unstressed contentives as it was for stressed and unstressed functors. Thus far, the only studies discussed which have controlled for short-term memory effects in verbal repetition tasks indicate that stressing appears to be a major factor in retention of sentential sequences (Beasley and Acker, 1971; Blasdell and Jensen, 1970).

How could stressing be interpreted in light of the model (see Figure 2)? The words receiving heavier stress also probably have a longer duration in relationship to the other unstressed words of the same length (Fry, 1955). This additional time could allow for their entrance into the long-term memory processing system and thus they are more permanently stored. Also the patterns of stress may allow for "chunking" to occur, i.e., large amounts of information may be processed simultaneously (Miller, 1956). Even though the short-term memory system may be limited, because of chunking, we can process, understand, and respond to verbal sequences which may exceed our immediate memory limits.

In early studies, digit memory spans were measured, and it was found that as the length of sequence increased,

the errors of substitution and omission increased. Miller (1956) discussed the subject of short-term memory and sequence length relative to information processing. He noted that unless some mnemonic technique is employed, such as chunking, the average sequence memory length of an adult is seven (words, digits, categories) plus or minus two. What Miller means by chunking is a method of seemingly expanding the immediate memory by grouping words or digits into categories which could be thought of as one. For example, the sequence 423679485957134 could be repeated by individuals who could group the digits as 423 (four hundred twenty-three), 679, 485, 957, 134, thus making a five item sequence. Perhaps stressed words in a sequence could also serve as a chunking device. Since Brown and Bellugi have stated that stressed words are often contentives which, by definition, are "high information" words, perhaps the only words necessary to remember or process are the contentives. The other words are discarded or at least recognized only briefly or in a scanning fashion.

Age as a Factor

Earlier it was noted that several factors may be operating during language acquisition to enhance the child's performance on repetition tasks. It is interesting to note that in the previous studies discussed the subjects were under five years of age and that no attempt was made by the researchers to test subjects of school age. Do children in

elementary school rely on the same "cues" for repetition tasks as do children who are just acquiring language? Or, does their experience with a learned language change their performance? Is there an age level at which sequence length, sequence formation (well-formed, ill-ordered, anomalous), word type (contentive or functor), and/or stressing no longer affect their responses?

Statement of Problem

When only one or two factors are examined at a time, the important characteristics of language acquisition may be obscured and the studies may perhaps lead to erroneous conclusions. It was therefore the purpose of this study to investigate the responses of first, third, and fifth grade children to an imitation task involving simultaneously the factors of sequence length, word type, sequence composition, and stressing upon sentence repetition tasks. Specifically, the following questions were asked relative to an imitation task:

1. What will be the recall accuracy of first, third, and fifth grade children for three, five, and seven word sequences?
2. What will be the recall accuracy of first, third, and fifth grade children for ill-ordered, anomalous, and well-formed verbal sequences?

3. What will be the recall accuracy of first, third, and fifth grade children for contentive and functor word-types?

4. What will be the recall accuracy of first, third, and fifth grade children for stressed and unstressed verbal stimuli?

5. Will the above factors and their various levels interact to produce differential recall accuracy for first, third, and fifth grade children?

CHAPTER II

EXPERIMENTAL PROCEDURES

Subjects

Ninety first, third, and fifth grade children--thirty at each grade level--from Mason Public Schools served as subjects. All children had normal articulation, language, and hearing as determined by the school's screening records for speech and hearing.

Design and Stimuli

The stimulus materials were the same used in a previous investigation of verbal imitation behavior by Beasley and Acker (1971). Eighteen three-, five-, and seven-word sequences, respectively, were recorded by an experienced phonetician on an Ampex AG44-4 tape recorder (frequency response of 50 to 15000 Hz). Six of each set of eighteen sequences were well-formed, six were anomalous, and six were ill-ordered in nature. In eighteen of the fifty-four sequences, one contentive per sentence was heavily stressed (six within each sentence type and two per like sentence length); in another eighteen of the sequences, one functor per sentence was heavily stressed

(six within each sentence type and two per like sentence length); and in another eighteen sequences, no lexical item was heavily stressed. The presence of stress was determined by listener judgment. The judges were fifteen graduate students in the department of Audiology and Speech Sciences at Michigan State University. Beasley and Acker (1971) found that the judges were able to correctly identify stressed words in the sequences with a better than 90 per cent accuracy. For the present study, sentences described in Appendix B were modified from the original sentences used by Beasley and Acker. Perceptual judgments on these sentences also revealed a better than 90 per cent accuracy of stress judgments.

Presentation Procedures

All sentences were presented in a randomized order (see Appendix C) via a Sony tape recorder TC-106A. All subjects heard all sentences and were asked to repeat exactly what they heard. Each subject sat approximately twenty-six inches directly in front of the speaker. The intensity level was set at 70 to 75 dB sound pressure level (SPL); re: .0002 dynes/cm^2. There was occasional peaking at 80 dB SPL. The ambient noise level in the test room was measured at 60 to 65 dB SPL on the C scale of a Brüel and Kjaer type 2204 sound level meter using a type 4145 sound field condensor michrophone. This ambient noise

level was sufficiently low so as not to interfere with the subjects' listening task.

After a brief greeting period, the examiner read a set of standardized instructions to each subject (see Appendix D). In addition to the three practice items given in the standardized instructions, an example of each type of sentence was given at the beginning of the experimental tape (see Appendix D). If any practice items were missed, they were repeated a second time. No subject required more than one repetition. Each subject was tested individually and was allowed fifteen seconds in response time between stimulus items. Beasley and Acker (1971) found fifteen seconds to be sufficient time to respond.

The responses of the subjects were written by the examiner on the answer sheet (see Appendix E). Recordings were also made of the subject's responses and played back at a later time. The examiner would check her original written record against the playback tape. In all but two words, there was 100 per cent agreement between the original data and the transcribed data. In those two cases the error was not scored.

Analysis

An error was defined as any word deleted or substituted. Order errors and addition errors, although transcribed, were not counted as errors.

All words in every sentence were classified into one of four categories: stressed contentive, unstressed contentive, stressed functor, and unstressed functor. The raw score errors were then converted into per cent scores (see Appendix G). The results were graphically displayed.

CHAPTER III

RESULTS

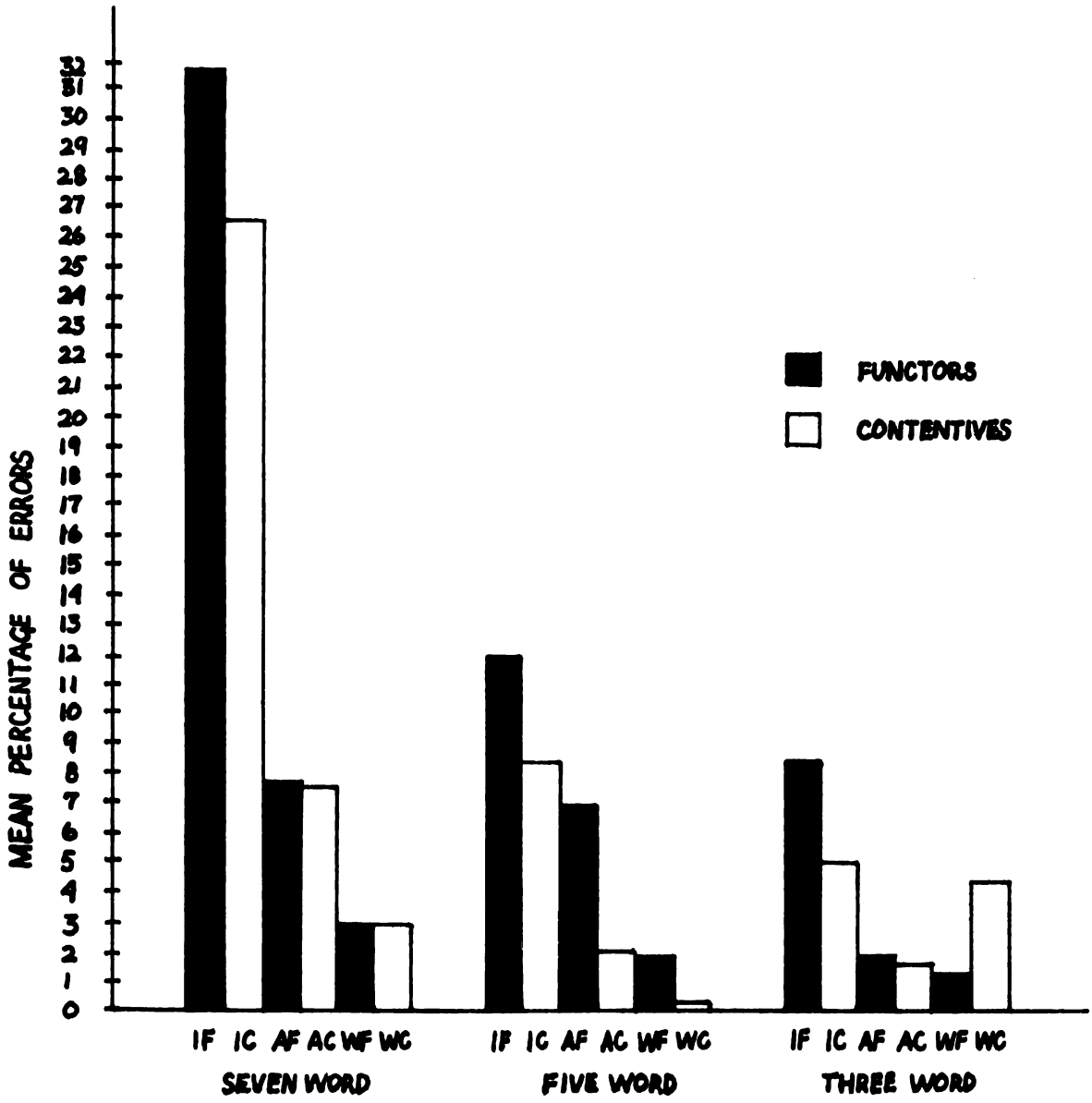
This study investigated the effects of sentence length, sentence type, word type, and stressing upon the imitation behavior of first, third, and fifth grade children. The results revealed consistent differences in imitation scores (i.e., per cent error) between the three grade levels as a result of the manipulation of the several factors under study, as well as their respective interactions. These results, discussed below, can be found labeled in Appendix F and graphically illustrated in Figures 2-11. A summary of the results has been included at the end of this chapter.

Effect of Sentence Length

Figures 2-7 indicate that, generally, as the number of words within the imitated unit increased, the number of errors in imitation increased. Further, there was a greater increase in the percentage of error made between the five- to seven-word sentences than between the three- to five-word sentences.

Figures 2-4 reveal the effect of sentence length as associated with sentence type (well-formed, anomalous, and

FIGURE 2.--Mean Percentage Error Scores: Sentence Length (three words long, five words long, seven words long) by Sentence Type (I = ill-ordered, A = anomalous, W = well-formed) and Word Type (F = functor, C = contentives).


MEAN PERCENTAGE OF ERRORS
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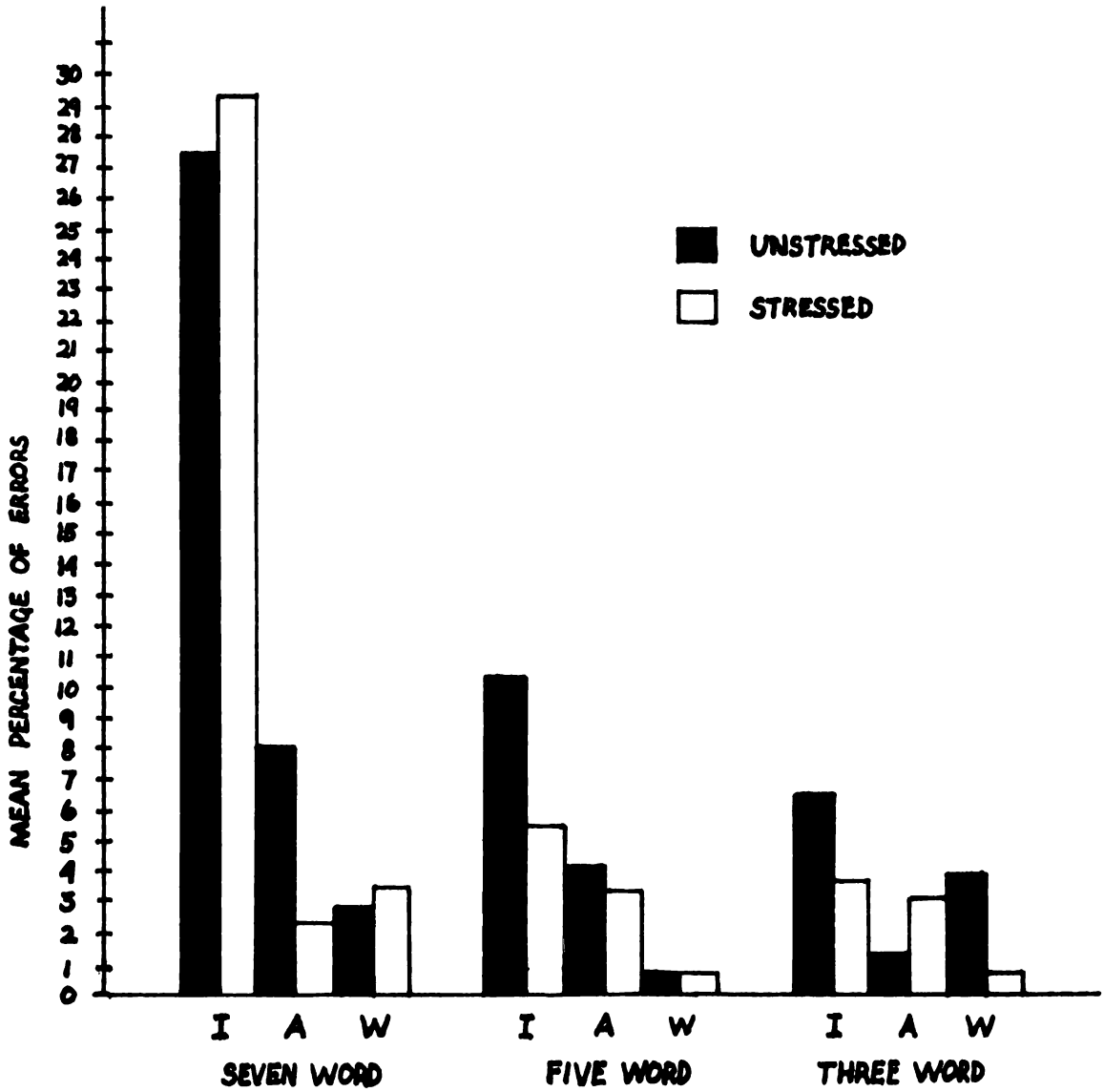
30
31
32
FUNCTORS
CONTENTIVES
IF IC AF AC WF WC
SEVEN WORD
IF IC AF AC WF WC
FIVE WORD
IF IC AF AC WF WC
THREE WORD

FIGURE 3

FIGURE 3.--Mean Percentage Error Scores: Sentence Length (three words long, five words long, seven words long) by Sentence Type (I = ill-ordered, A = Anomalous, W = well-formed) and Stress (S = stressed, U = unstressed).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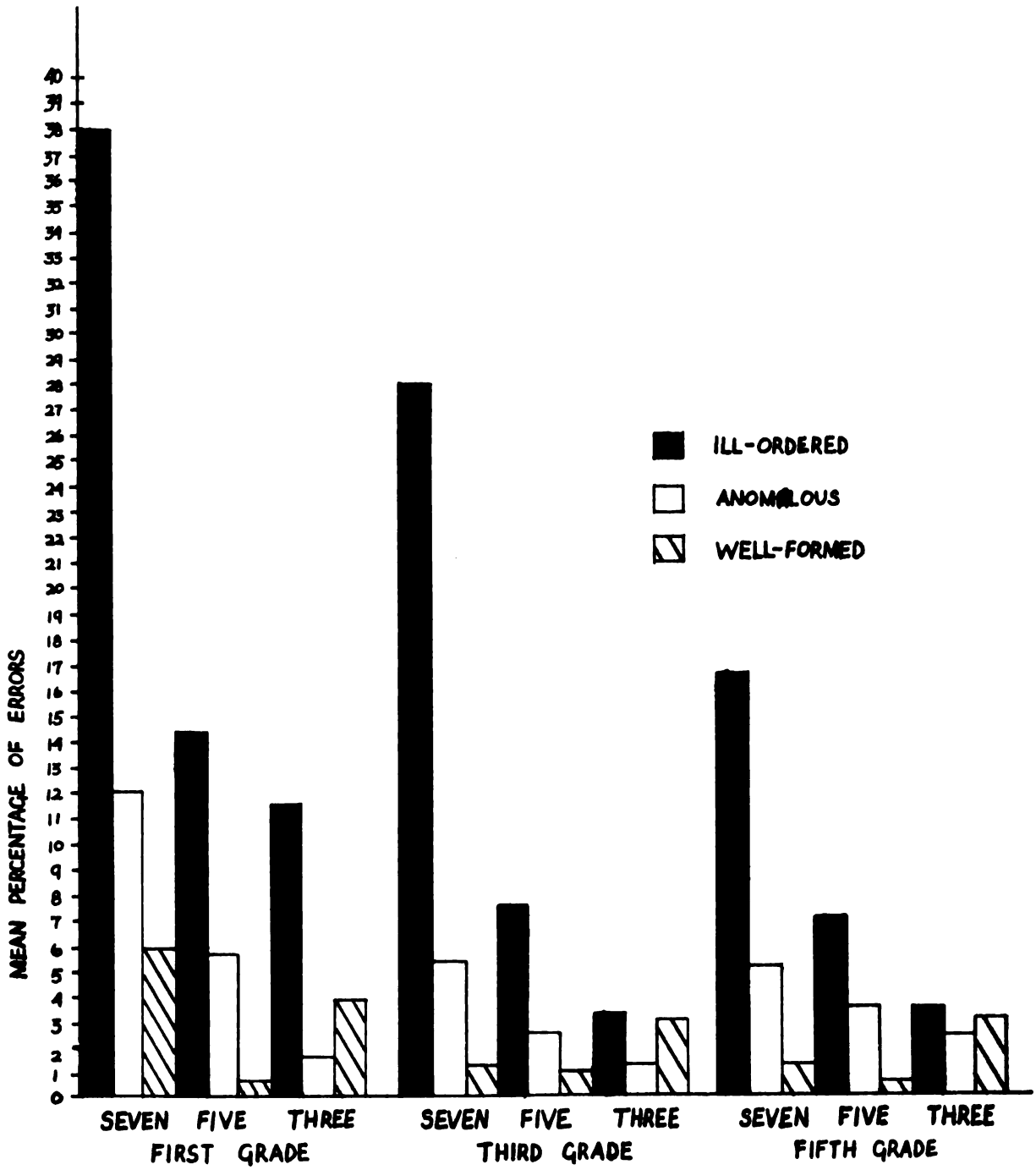
26
27
28
29
30
UNSTRESSED
STRESSED
I A W
SEVEN WORD
I A W
FIVE WORD
I A W
THREE WORD

FIGURE 3

FIGURE 4.--Mean Percentage Error Scores: Sentence Length (three words long, five words long, seven words long) by Sentence Type (I = ill-ordered, A = anomalous, W = well-formed) and Grade Level (first grade, third grade, fifth grade).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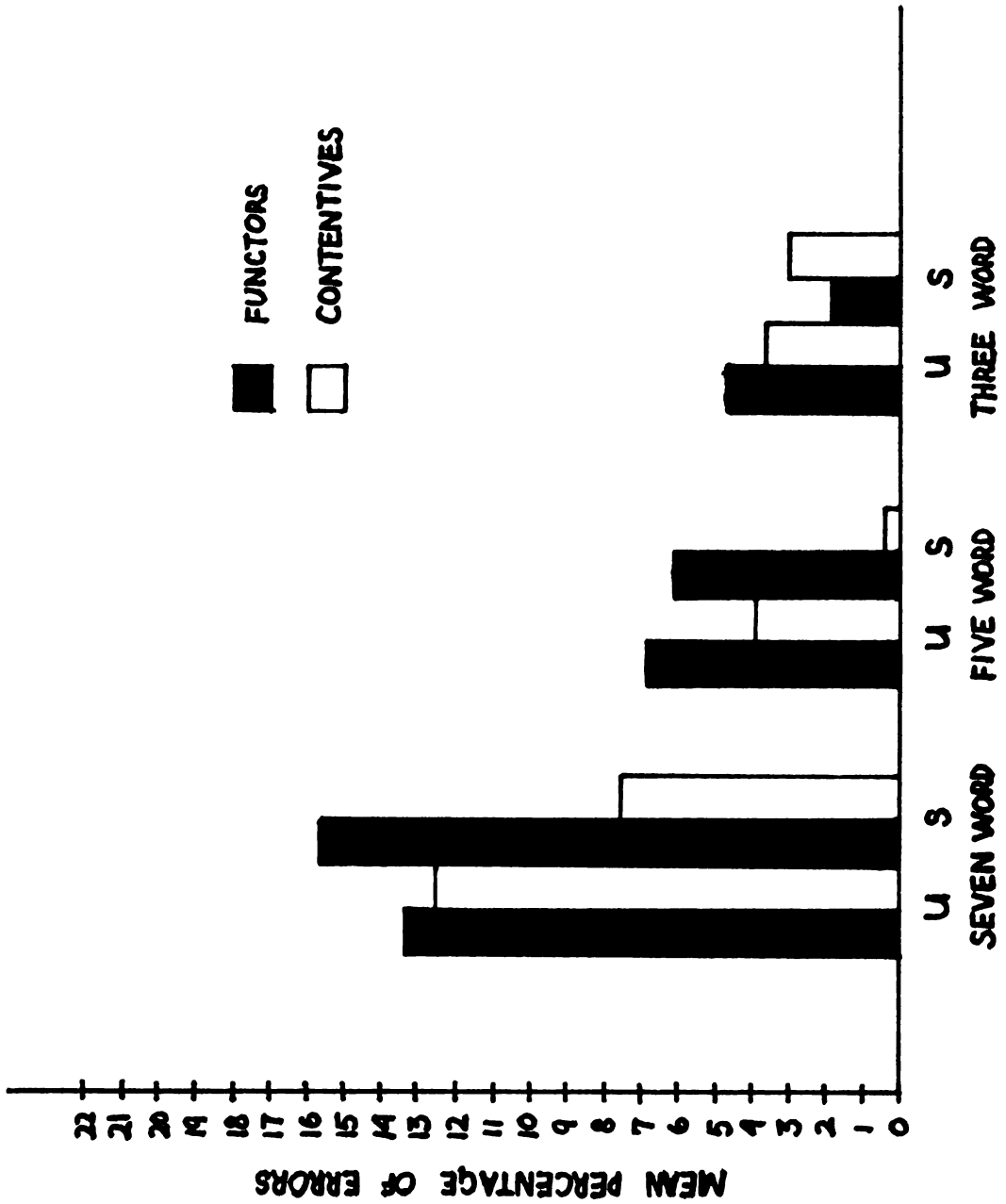
40
ILL-ORDERED
ANOMALOUS
WELL-FORMED
SEVEN FIVE THREE
FIRST GRADE
SEVEN FIVE THREE
THIRD GRADE
SEVEN FIVE THREE
FIFTH GRADE

FIGURE 4

FIGURE 5.--Mean Percentage Error Scores: Sentence Length (three words long, five words long, seven words long) by Word Type (C = contentive, F = functor) and Stress (S = stressed, U = unstressed).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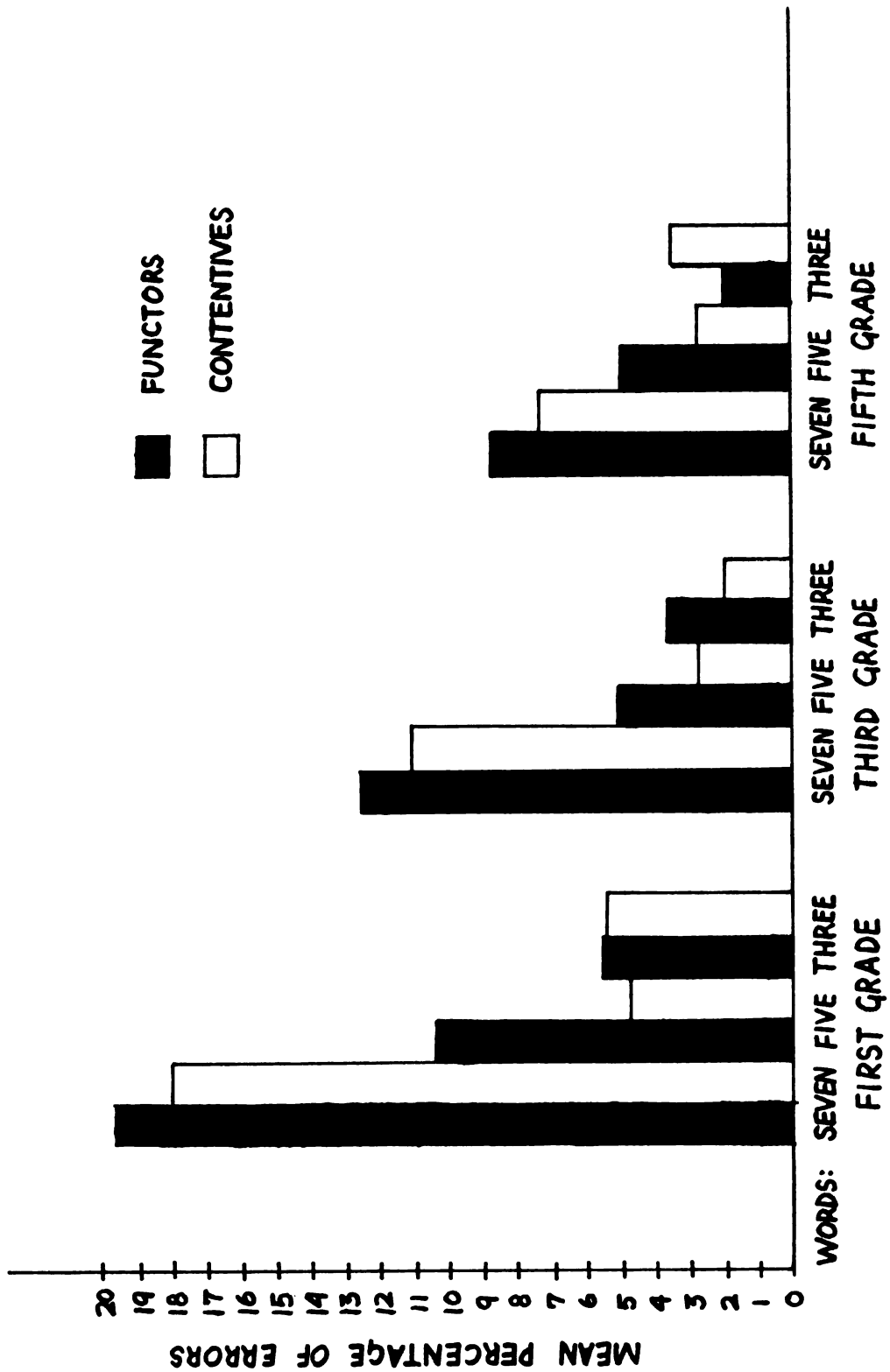
22
FUNCTORS
CONTENTIVES
U S
SEVEN WORD
U S
FIVE WORD
U S
THREE WORD

FIGURE 5

FIGURE 6.--Mean Percentage Error Scores: Sentence Length (three words long, five words long, seven words long) by Word Type (F = functors, C = Contentives) and Grade Level (first grade, third grade, fifth grade).


MEAN PERCENTAGE OF ERRORS
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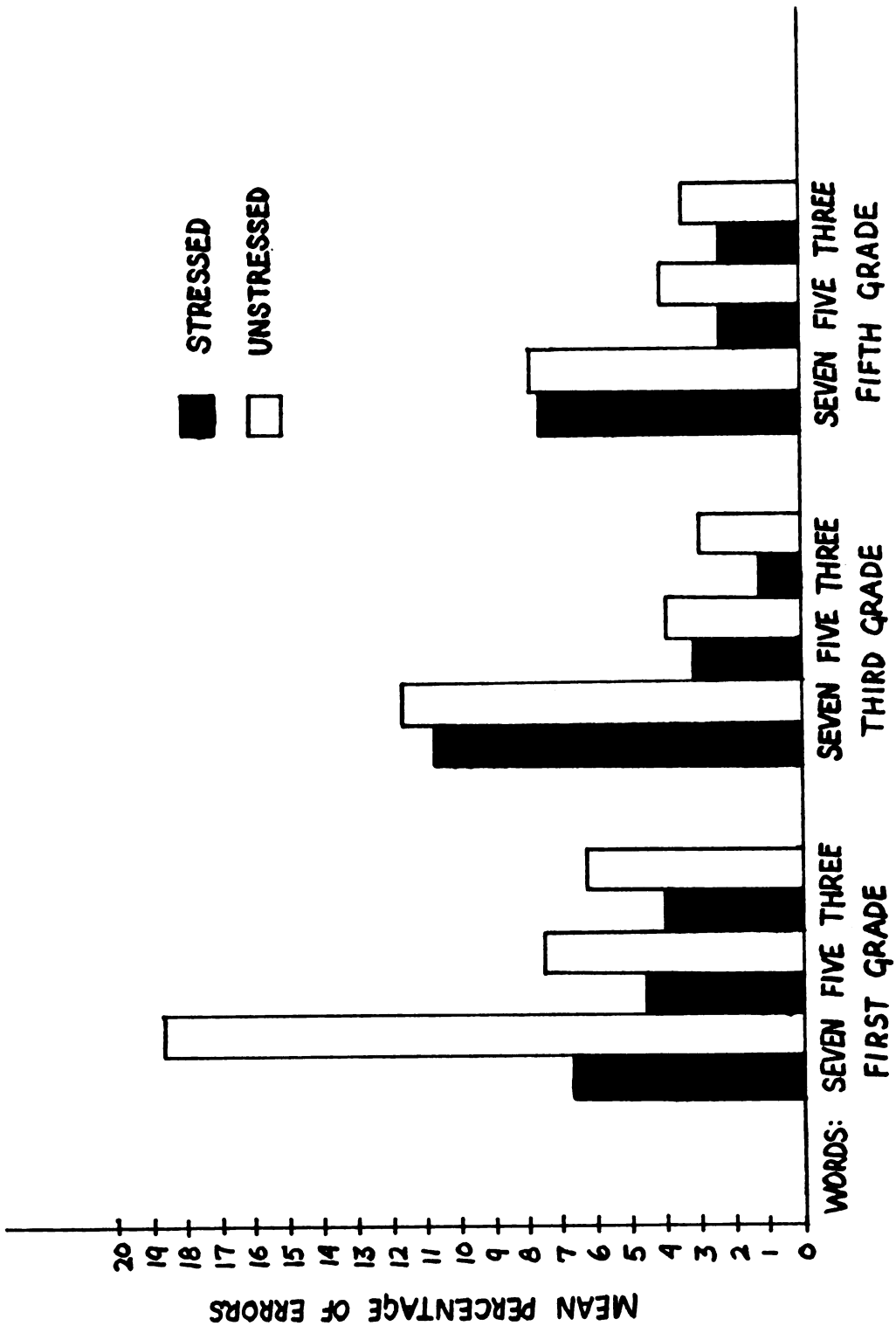
19
20
FUNCTORS
CONTENTIVES
WORDS: SEVEN FIVE THREE
FIRST GRADE
SEVEN FIVE THREE
THIRD GRADE
SEVEN FIVE THREE
FIFTH GRADE

FIGURE 6

FIGURE 7.--Mean Percentage Error Scores: Sentence Length (three words long, five words long, seven words long) by Stress (S = stressed, U = unstressed) and Grade Level (first grade, third grade, fifth grade).


STRESSED
UNSTRESSED
MEAN PERCENTAGE OF ERRORS
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14
15
16
17
18
19
20
WORDS: SEVEN FIVE THREE
FIRST GRADE
SEVEN FIVE THREE
THIRD GRADE
SEVEN FIVE THREE
FIFTH GRADE

FIGURE 7

ill-ordered). As can be seen, the error rate increased as the number of words in the sentence increase for all three sentence types. In addition, there was a trend for well-formed sentences to be least affected by sentence length, followed by anomalous and ill-ordered, respectively. The single exception to this trend occurred in three-word sentences. In this case, more errors occurred in three-word well-formed than in anomalous sequences. This will be discussed in Chapter IV. However, the greatest error rate occurred in three-word ill-ordered sentences.

Figures 2, 5, and 6 reveal the effect of sentence length as associated with word type (functors and contentives). As illustrated, the functors tended to show an increased error rate as sentence length increased. However, the contentives showed a similar error rate for three- and four-word sequences but an increased error rate for seven-word sequences.

Figures 3, 5, and 7 show the effect of sentence length in conjunction with stressing. Generally, error rate increased for both the stressed and unstressed stimuli as sentence length increased, with the greatest increase occurring in seven-word sequences. Further, as sentence length increased, the difference between the stressed and unstressed stimuli error rate decreased.

Figures 4, 6, and 7 depict the effect of sentence length as it interacts with grade. As a general trend,

error rate decreased as grade level increased for all three sentence lengths. This effect was most prominent for seven-word sequences. On three- and five-word sequences, differences between third and fifth graders were minimal.

Figure 2 depicts the three way interaction of sentence length with sentence type and word type. The trend indicated that as sentence length increased, error rate increased within each sentence type (ill-ordered, anomalous, well-formed) for both functors and contentives. The one exception was that the error rate for three-word well-formed contentive errors was higher than the error rate for five- and seven-word well-formed contentive sequences. In seven-word ill-ordered sequences, there was a higher error rate in functor word types than in contentive types. A similar relationship between functors and contentives existed for five-word and three-word ill-ordered sequences. Five-word anomalous error rate was higher for functor types than for contentive. Little difference existed between contentive and functor error rates for seven- and three-word anomalous and for seven-word well-formed sequences. In three-word well-formed sentences, contentive errors occurred at a higher rate than functor errors. There was a trend for ill-ordered sequence error rates to be higher than anomalous sequence error rates for functors. Functor error rates associated with anomalous sequences were higher than well-formed sequences with the

exception that three-word anomalous were not higher than seven-word well-formed sentences.

The same sentence type trends existed for contentives with the following exceptions: seven word anomalous had higher error rate than three-word ill-ordered (same as functor), seven-word well-formed sentences had more errors than three-word anomalous sequences, and three-word well-formed sequences demonstrated more errors than seven- and five-word well-formed or three-word anomalous sequences.

Figure 3 depicts the interaction of sentence length with sentence type and stressing. Generally, as sentence length increased within each sentence type, the error rate increased for unstressed words. An exception occurred in three-word well-formed sentences for the unstressed condition, where the error rate was higher than for either seven- or five-word well-formed sentences. As sentence length increased the error rate increased in ill-ordered sequences under the stressed condition. No trend could be seen for length among anomalous sequences for the stressed condition. Seven-word well-formed sentences had more errors than five- and three-word well-formed sentences under the stressed condition.

Figure 4 shows the relationship of sentence length, sentence type, and grade level. Seven-word ill-ordered sentences had the highest error rate in each grade level. For seven-word ill-ordered sequences the error rate

decreased as grade increased. Error rate decreased in the following order for all grades: seven-word ill-ordered types, five-word ill-ordered types, seven-word anomalous, three-word ill-ordered. For these conditions, error rate was higher for first graders than third or fifth graders. The differences between third and fifth grades were minimal, except perhaps for seven-word sequences. No grade associated trend was observed for seven- and three-word well-formed sentences, or five- and three-word anomalous sequences. The differences between first, third, and fifth graders were minimal for all of these conditions. The lowest error rate for all grades occurred on the five-word well-formed sentences, and again the differences between grade levels were minimal.

Figure 5 shows the interaction of sentence length with word type and stress. The trend showed that as sentence length decreased, error rate decreased within each word type stress combination. The exception to this trend occurred in the stressed contentive combination where it was found that as sentence length decreased from five words to three words, the error rate increased. Combinations including functors comprised the greatest error rate in seven-word and five-word sequences. Combinations including unstressing had the greatest error rate in three-word sequences. The words with the lowest error rate for each sentence length were stressed.

Figure 6 depicts the results of sequence length by word type and grade level. For all grade levels, as sentence length decreased, error rates decreased for functors. Seven-word sentences with contentives had a higher error rate than did five- and three-word sentences for all grade levels. The differences between contentives in three- and five-word sentences were minimal. For all grade levels and within each sentence length, there was a trend for a higher error rate to occur with functors than with contentives. The exception to this trend was found in the three-word sentence type for fith graders.

Figure 7 shows the relationship of sentence length and stressing by grade level. As sentence length decreased, error rates decreased for stressed and unstressed words at all grade levels. Stressed words had fewer errors at all sentence lengths for all grade levels than did unstressed words. Error rates for first graders were higher for all sentence lengths and conditions of stressing than were error rates for third and fifth graders. Error rates for third graders were greater than error rates for first graders for seven-word sentences but the differences in error rates diminished (and in fact were reversed for three-word sentences with conditions of stress) on five- and three-word sequences.

Effect of Sentence Type

Figures 2, 3, 4, 8, 9, and 10 indicate that error rate was highest for ill-ordered sentences, lower for anomalous types, and lowest for well-formed sentences.

The relationship between sentence type and sentence length as shown in Figures 2-4 was revealed earlier. The trend indicated that error rates increased as sentence length increased, that more errors occurred in ill-ordered than anomalous sequences, and that errors in anomalous sentence types were greater than well-formed types.

Figures 2, 8, and 9 show the influence of sentence type on word form. The greatest error rate for functors and contentives were made in ill-ordered sentences. Fewer word type errors were made on anomalous sentences and well-formed sequences, respectively. There appeared to be little difference between contentive and functor errors. Functor error rates were greater than contentive error rates on anomalous and ill-ordered sentences, but contentive error rate was higher than functor error rate on well-formed sequences.

Figures 3, 8, and 10 show the relationship between sentence type and stressing. More unstressed word errors occurred than stressed word errors. The greatest error rate for both stressed and unstressed conditions occurred in ill-ordered sentence types. A lower error rate was demonstrated in anomalous types, and the lowest error rate occurred in well-formed sentences.

FIGURE 8.--Mean Percentage Error Scores: Sentence Type (IO = ill-ordered, A = anomalous, WF = well-formed) by Word Type (C = contentives, F = functors) and Stress (U = unstressed, S = stressed).

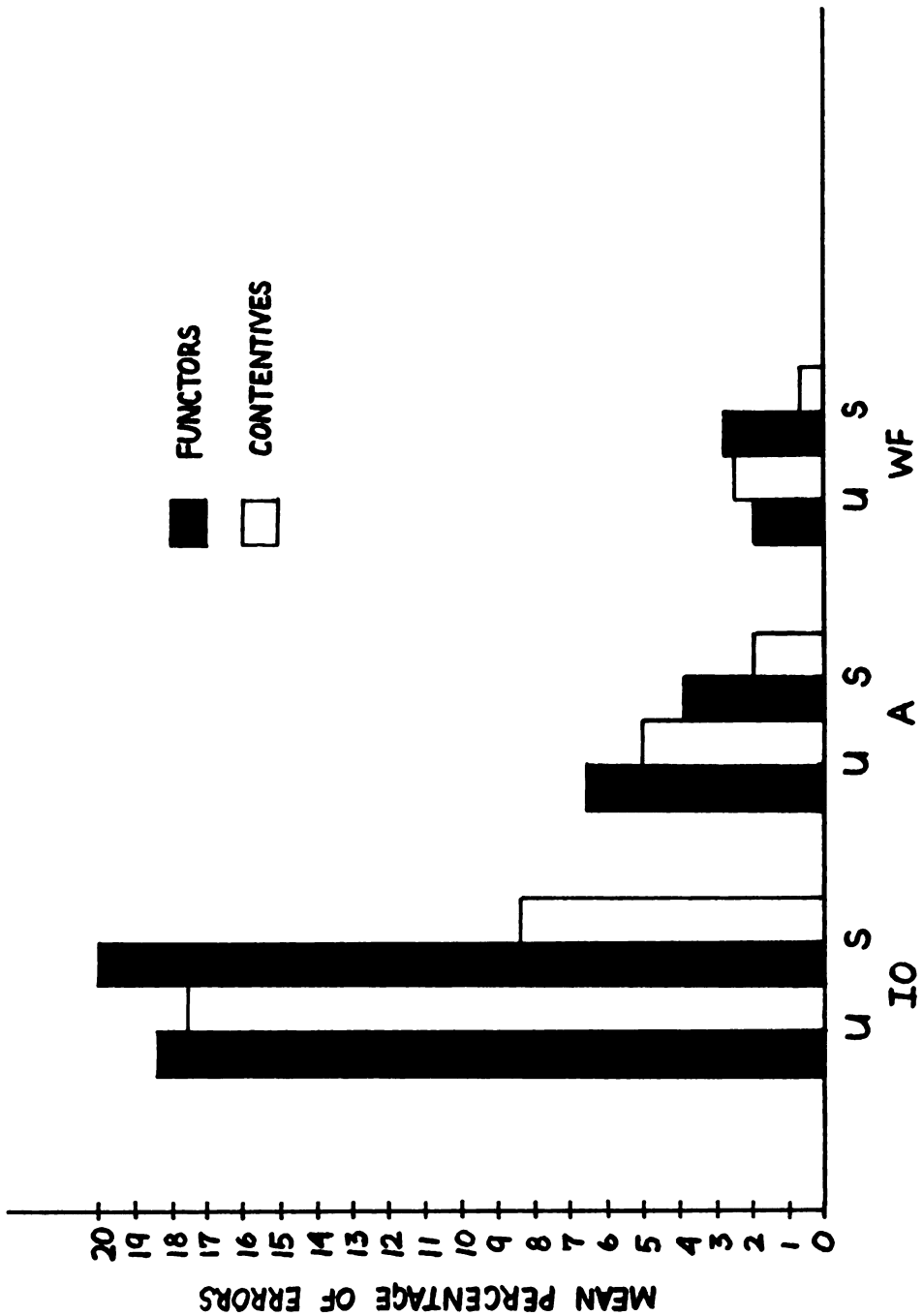
MEAN PERCENTAGE OF ERRORS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
FUNCTORS
CONTENTIVES
U S
IO
U S
A
U S
WF

FIGURE 8

FIGURE 9.--Mean Percentage Error Scores: Sentence Type (I = ill-ordered, A = anomalous, W = well-formed) by Word Type (F = functors, C = contentives) and Grade Level (first grade, third grade, fifth grade).

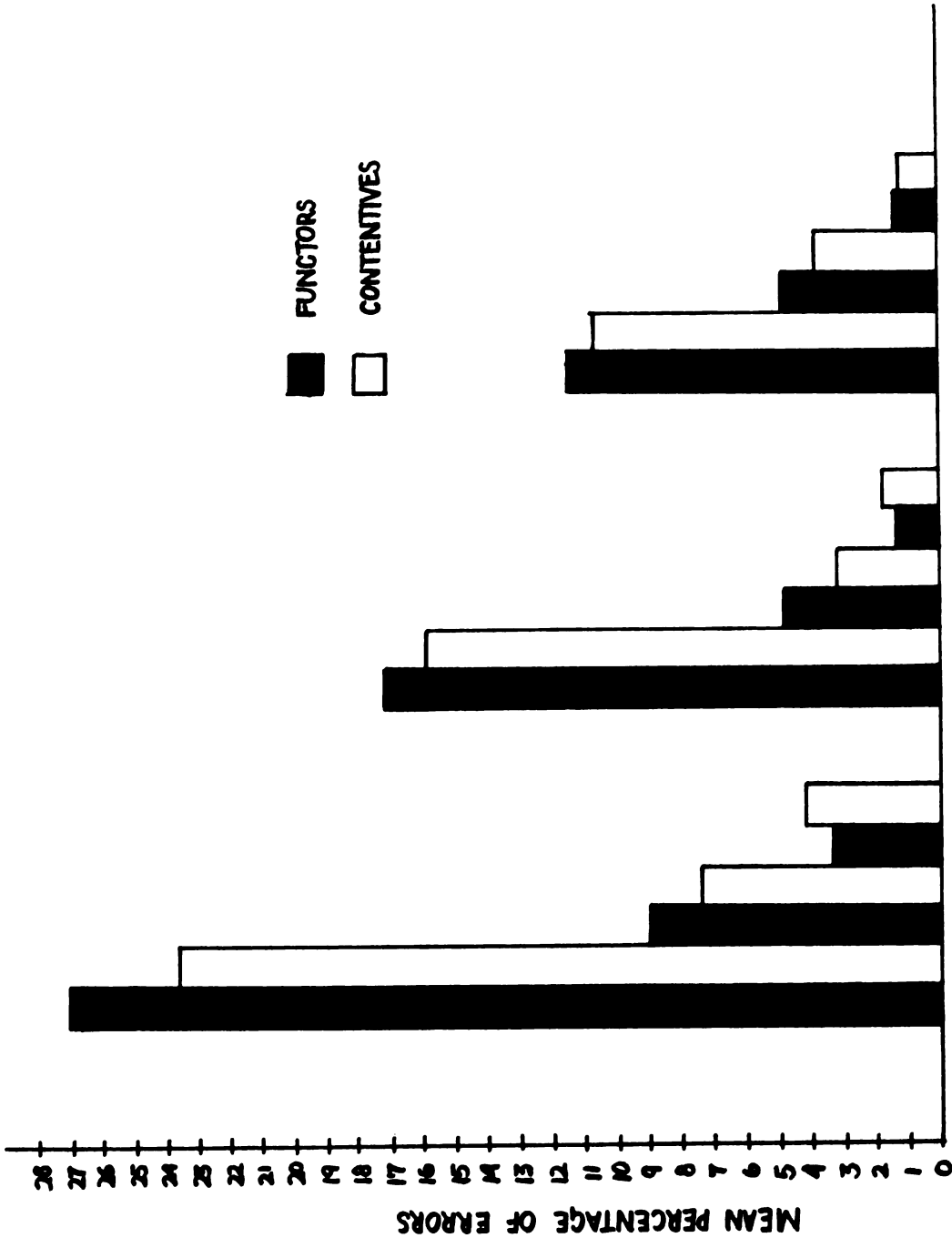
FUNCTORS
CONTENTIVES
MEAN PERCENTAGE OF ERRORS
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
I A W
FIRST GRADE
I A W
THIRD GRADE
I A W
FIFTH GRADE

FIGURE 9

FIGURE 10.--Mean Percentage Error Scores: Sentence Type (I = ill-ordered, A = anomalous, W = well-formed) by Stress (S = stressed, U = unstressed) and Grade Level (first grade, third grade, fifth grade).

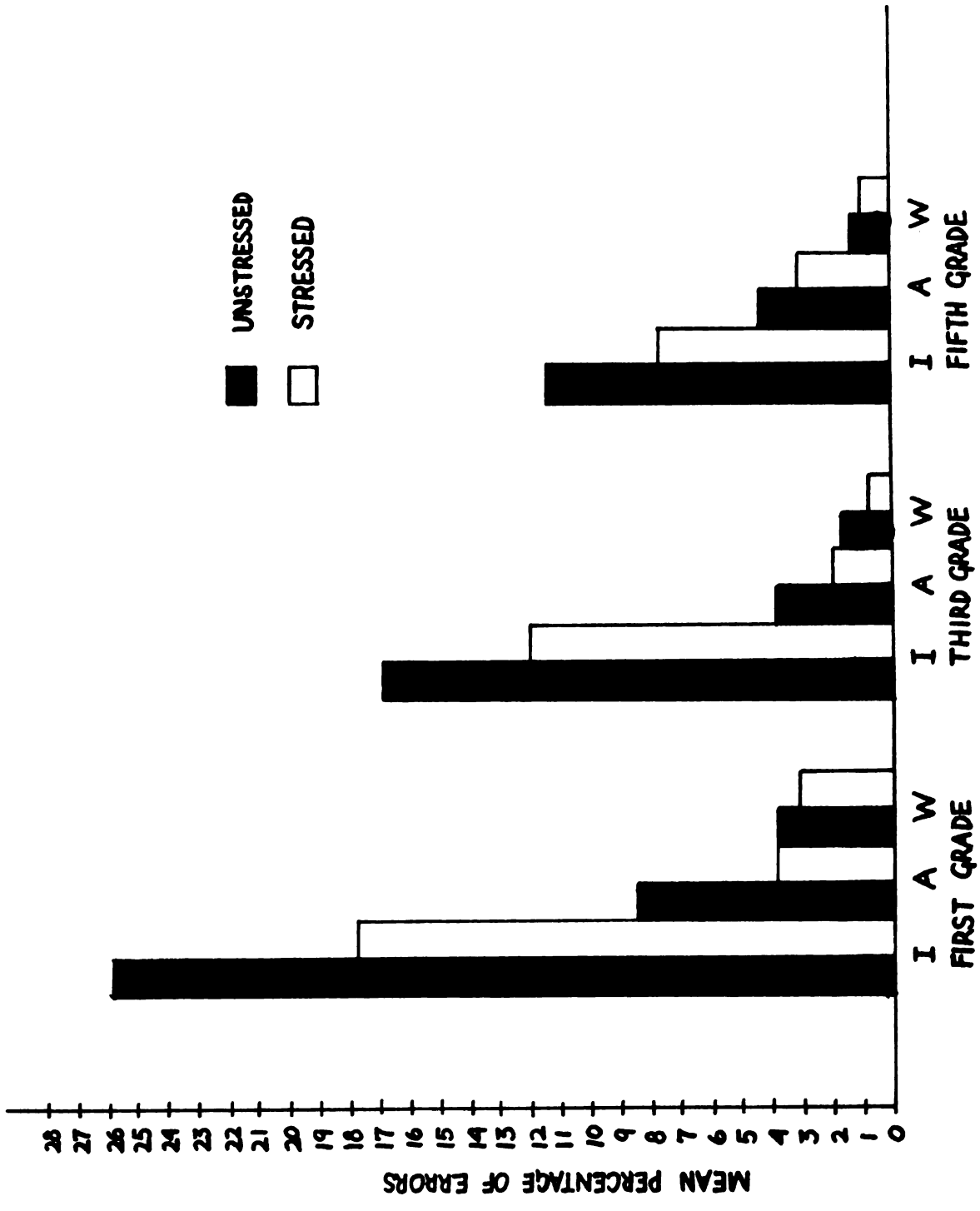
UNSTRESSED
STRESSED
MEAN PERCENTAGE OF ERRORS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
I A W
FIRST GRADE
I A W
THIRD GRADE
I A W
FIFTH GRADE

FIGURE 10

In Figures 4, 9, and 10 sentence type and grade level are depicted. All grade levels had the highest error rate in ill-ordered sentence types, followed by anomalous sentences and well-formed sentences, respectively. As grade level increased, there was a trend for error rates to decrease. The exception to this trend involved anomalous type sentences where third graders made fewer errors than fifth graders.

Three three-way interactions involving the effect of sentence type with sentence length and word type, sentence length and stress, and sentence length and grade level were described earlier (see Figure 2). Generally, the trends indicated that ill-ordered sequences had higher error rates than anomalous or well-formed sequences of the same length, regardless of the condition of stress, word type, or grade level. Anomalous sequences had more errors than well-formed sentences for the same length regardless of stress, word type, or grade level, with the following exceptions: three-word well-formed sentences had higher error rates than three-word anomalous sentences if contentive errors only, or errors of unstressing, were considered.

Figure 8 depicts the interaction of sentence type with word type and the two conditions of stress. The main effect showed a higher error rate for ill-ordered sentence types than for anomalous or well-formed types, regardless

of word type or stress. Anomalous sequences had a higher error rate than well-formed sentences within each combination of stress and word type. These differences were less than the differences between ill-ordered and anomalous sequences. For all three sentence types, the lowest error rate occurred with stressed contentive type words. No trends could be seen for the other error rates across the three sentence types for like word type and stress patterns.

Figure 9 depicts the three-way interaction of sentence type with word type and grade. Within ill-ordered and anomalous sentences the functor error rates were higher than the contentive error rates for all grade levels. However, for well-formed sentences contentive error rates were higher than functor error rates for the first grade level, and little differences appeared for the third and fifth grade levels. Error rates for ill-ordered sequences were higher than error rates for anomalous types for both word types and all grades. Anomalous error rates were higher than well-formed error rates for both word types in all grades. Figure 10 also shows that first graders had higher error rates than third and fifth graders for corresponding sentence types and word types. Third graders had more errors on contentives and functors in the ill-ordered sequences than fifth graders. Error rate differences between third and fifth graders for anomalous and well-formed sequences and word types were minimal. In

well-formed sentences there was little difference between number of contentive and functor errors for all grades.

Figure 10 shows the relationship of sentence type, stress, and grade level. There was a trend for more errors to occur on unstressed words than stressed words over all grade levels and within all sequence types. More errors occurred in ill-ordered than in anomalous sequences within the same condtions of stress for all grade levels. Further, more errors occurred in anomalous sequences than in well-formed sentences within the same conditions for stressing in all grade levels. Fifth graders had higher error rates than third graders on anomalous sequences for both stress and unstressed conditions.

Effect of Word Type

Figures 2, 5, 6, 8, 9, and 11 show that the error rate was greater for functors than contentives. The interaction of word type with sentence length and sentence type has been discussed earlier (see Figure 2).

Figures 5, 8, and 11 depict the interaction between word type and stress. Generally, unstressed error rates were higher than stressed error rates for both functors and contentives. The difference between the error rate for stressed and unstressed words was greater for contentives than for functors.

Figures 6, 9, and 11 show the interaction of word type and grade level. As can be seen, error rate for both

FIGURE 11.--Mean Percentage Error Scores: Word Type (F = functors, C = contentives) by Stress (S = stressed, U = unstressed) and Grade Level (first grade, third grade, fifth grade).

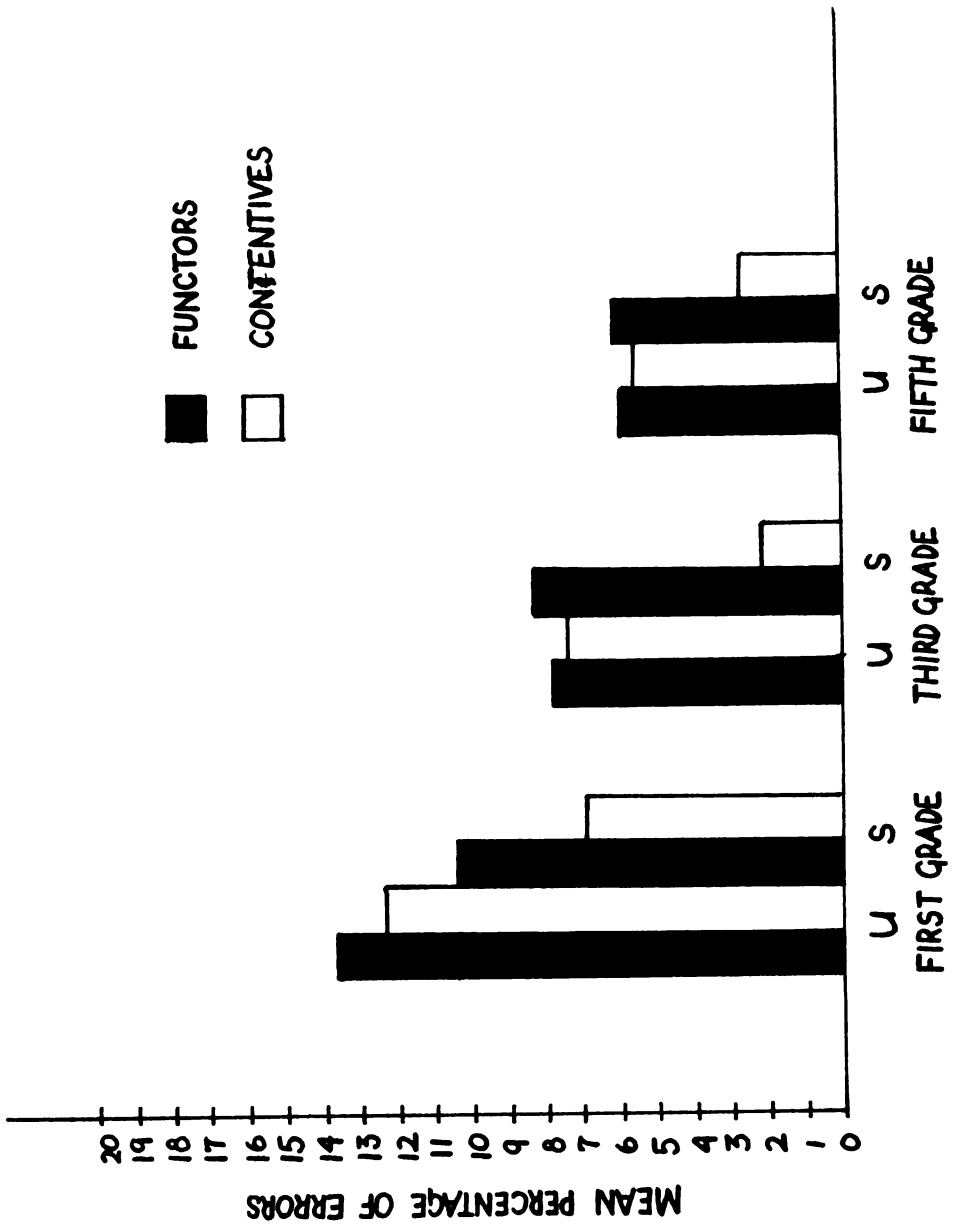
FUNCTORS
CONTENTIVES
MEAN PERCENTAGE OF ERRORS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
U S
FIRST GRADE
U S
THIRD GRADE
U S
FIFTH GRADE

FIGURE 11

word types decreased as grade level increased. Functors had a higher error rate than contentives for all three grade levels.

Three-way interactions combining word type with sentence length, sentence type, and grade level have been discussed in detail (see Figure 6). Generally, the functor error rate exceeded the contentive error rate. The exceptions, when they occurred, fell in the three-word sequences and well-formed types.

Figure 11 depicts the relationship of word type stress, and grade level. As can be seen, the unstressed contentives had a higher error rate than the stressed contentives over all grade levels. The same relationship existed in functor word types for first grade. Differences between stressed and unstressed functors were minimal for third and fifth graders. There was a trend for error rate to decrease as grade level increased within each combination of stress and word type. The exception was in the stressed-contentive combinations between third and fifth grades, whereby an inverse relationship occurred. The difference between third and fifth graders were again minimal.

Effect of Stressing

Figures 3, 5, 7, 8, 10, and 11 show a higher error rate for unstressed words than for stressed words. The interaction of stressing with sentence length, sentence type, and word type has already been discussed (see Figures

3 and 5). Generally, error rate increased for both the stressed and unstressed words as sentence length increased. The error rate for stressed and unstressed words was lowest for well-formed sentences, followed by anomalous and ill-ordered sentences, respectively. Usually, unstressed functors and contentives had higher error rates than stressed functors and contentives.

Figures 7, 10, and 11 show the effect of stressing by grade level. As grade level increased, errors on stressed and unstressed words decreased. The percentage of error on unstressed words was greater than stressed words at all grade levels.

All possible three-way interactions involving stress and the other combinations of sentence length, sequence type word forms, and grade level have been discussed earlier (see Figures 3, 5, 7, 8, 10, and 11). In looking at stress as it interacts with sentence length and sentence type, exceptions to the trend for higher error rates among un-stressed words occurred in seven-word and three-word anomalous type sequences, and seven-word and five-word well-formed type sequences (see Figure 3). In viewing the interaction of stress, sentence length, and word type, there was a trend for higher error rates to occur on functors regardless of stress pattern, with the exception of the stressed functor word type in three-word sequences (see Figure 5). In looking at stress as it related to

sentence length and grade level, consistent patterns were found in error rates of stressing associated with sentence length and grade. All unstressed words had a higher error rate than the stressed words within the same sequence length at all grade levels (see Figure 7). As stress interacts with sentence type and word type, one consistent trend indicated that stressed contentives had the lowest error rate for all sequence types. More errors were made in ill-ordered sequences for all combinations of word type and stress than in anomalous and well-formed sequences (see Figure 8).

Finally, when stress interacts with sentence type and grade level, all unstressed words had higher error rates than stressed words within all sentence types for all grades. Error rate again decreased as grade level increased (see Figure 10).

Effect of Grade Level

Figures 4, 6, 7, 9, 10, and 11 indicate that the number of errors decreased as the grade level increased. The greatest decrease in errors occurred between the first and third grade level.

As reported earlier, grade level interactions with sentence length, sentence type, word type, and stress were shown in Figures 4, 6, 7, 9, 10, and 11.

Briefly, as can be seen in Figures 5, 7, and 8, errors increased as sentence length increased over all grade

levels. The increase was greatest for three- and seven-word sentences. Third and fifth graders showed little difference in percentage of errors for three- and five-word sentences.

Figures 4, 9, and 10 show that first grade children had more errors on every sentence type than did third and fifth graders. Third graders tended to do better on anomalous types than did fifth graders.

Figures 6, 9, and 11 show that functors had a higher error rate than contentives for all grade levels. As level increased error rate decreased for both contentives and functors.

Figures 7, 10, and 11 show a higher error rate on unstressed words than on stressed words for all grade levels.

Three-way interactions involving all possible combinations of sentence length, sentence type, word type, stress, and grade have also been discussed above (see Figures 4, 6, 7, 9, 10, and 11).

The main effect present in all three-way interactions involving grade level showed that first graders made more errors than third and fifth graders within each specific combination of variables. The differences between third and fifth graders were minimal with the following exceptions: seven-word ill-ordered sequences (Figures 4, 9, and 10), seven-word contentives and functors (Figure 11), seven-word stressed and unstressed conditions (Figure 7), ill-ordered functors and contentives (Figure 9), and ill-ordered stressed and unstressed conditions (Figure 10). In

these cases more than minimal differences existed and followed the general trend for all grade level comparisons: as grade level increased, errors decreased.

Summary of Results

The main effects which seemed most prominent were sentence length, sentence type, word type, and grade level. Briefly, error rates increased as sentence length increased. Error rates were greatest for ill-ordered sequences, followed by anomalous and well-formed sequences, respectively. Contentives had lower error rates than functors. Finally, error rates decreased as grade level increased.

The two-way interactions which seemed most profound were: sentence length by sentence type, sentence length by word type, stress by word type, sentence length by grade level, and sentence type by grade level.

Sentence length and sentence type generally followed this pattern: seven-word sequences had the highest error rate over all sentence types, followed by five-word and three-word sequences, respectively. Within each sentence length, ill-ordered sequences had the highest error rate, followed by anomalous and well-formed sequences, respectively. The exception occurred in well-formed, three-word sequences where the error rate was higher than five- and seven-word, well-formed sequences and than three-word, anomalous sequences.

Sentence length interacted with word type in three-word sequences where error rates for contentives and functors were similar. In seven- and five-word sequences, functor error rates were higher than contentive error rates.

The difference between stressed and unstressed error rates were minimal for functor word types and greater for contentive word types. Unstressed error rates remained greater than stressed error rates.

First graders had greater error rates than third and fifth graders, respectively, on seven-word sequences. On five- and three-word sequences, however, the differences in error rate between third and fifth graders were minimal.

Generally, error rate decreased as grade level increased for all sequence types; however, in anomalous sequences, fifth graders had a higher error rate than did third graders.

Three-way interactions which seemed most evident were: sentence length by sentence type and stress, sentence length by sentence type and word type, and sentence length by word type and stress.

In seven-word sequences, unstressed error rates were lower than stressed error rates for ill-ordered and well-formed sequences. While in anomalous sequences, the error rate for stressed words was lower than for unstressed words. In five-word sequences, unstressed error rates were higher than stressed error rates in ill-ordered and anomalous sequences, but in well-formed sequences, the stressed and

unstressed error rates were about the same. In three-word sequences, unstressed error rates were higher than stressed error rates for ill-ordered and well-formed sequences, but in anomalous sequences, unstressed error rates were lower than stressed error rates.

An interaction of sentence length, sentence type, and word type occurred in three-word, well-formed sequences. In this case, contentive error rates were higher than functor error rates. Usually, functor error rates were higher than contentive error rates within all three sequence lengths and across all three sequence types.

Finally, sentence length, word type, and stress interact. In seven-word sequences, stressed functors showed higher error rate than unstressed functors. Also, stressed contentives had higher error rates in three-word sequences than in five-word sequences.

While other interactions were reported in the body of the results chapter, this summary mentions the most striking data.

CHAPTER IV

DISCUSSION

The results indicated that sentence length, sentence type, word type, stress, and grade level interacted at various levels. Further, specific variables in certain cases took precedence over others in affecting the recall accuracy of children on this imitation task. Earlier studies had not investigated the simultaneous interactions of these several variables upon imitation behavior, thus limiting possible conclusions and generalizations about imitation behavior. The present study has, to a large extent, overcome that problem. However, in order to generalize about the behavior of individuals, trends must be found and, further, any exceptions to those trends must be explained in the same context as the trends. The trends of the present study have been identified and the exceptions mentioned. Now, the trends will be related to prior work, and the exceptions will be discussed.

Trends Related to Prior Work

In viewing the variables independently of each other, the results of the present study support earlier

investigations. The trend for error rates to increase as sentence length increased supports the findings of earlier studies of sentence length, item length, and short-term memory (Aaronson, 1967; Miller, 1956; Schuckers, Shriner, and Daniloff, 1971). When a string of items (words or digits) has exceeded the immediate or short-term memory span of an individual, that individual tends to delete words or digits from the string. Miller (1956) found that the short-term memory span was usually seven items long, plus or minus two. This present study found that more words were deleted or incorrectly remembered from seven-word sequences, followed by five- and three-word sequences, respectively.

The fact that more errors occurred in ill-ordered sequences, followed by anomalous and well-formed sequences, respectively, supports the studies of Beasley and Acker (1971), Brown and Bellugi (1964), and Scholes (1970). The trend for higher rates to occur on unstressed words than on stressed words also agrees with earlier studies (Beasley and Acker, 1971; Blasdell and Jensen, 1970). Finally, error rated decreased as grade level increased. Previous studies dealing with some combination of the five factors under investigation in the present study did not use school age children as subjects. However, the same trends had been found with pre-schoolers: As age increased, error rate decreased (Beasley and Acker, 1971; Scholes, 1970).

Sentence Length

As the results indicated, error rate increased as sentence length increased. It was evident that there was a greater error rate increase between the five- and seven-word sequences than there was between the three- and five-word sequences. When word length increased to seven, then the increase in percentage of errors may have indicated that short-term memory storage capacity and/or processing capability had been exceeded. When immediate memory limits have been exceeded, then recall becomes selective and must reflect strategies used by the listener in processing the information he must repeat or imitate. Further support that seven-word sequences exceeded short-term memory span can be seen when total sequence deletions were counted. Twenty-seven seven-word sentences were completely deleted while only four sentences were completely deleted in both five- and three-word sequences, respectively. The type of words retained by the subjects on seven-word sequences may very well reflect upon the strategies used by individuals to select words to repeat or imitate. If a trend emerges in the selection of words to be retained, it is plausible that individuals use similar cues in other tasks which make use of imitation.

Sentence length as it interrelates with sentence type presents an interesting phenomenon. Within five- and seven-word sentences, more errors were found in ill-ordered

types, followed by anomalous and well-formed, respectively. This does seem to indicate that there is a distinction between syntactically correct versus semantically meaningful sentences in terms of word retention. That is, the importance of syntactic completeness for recall accuracy is emphasized. An exception to the trend occurred in three-word sequences where well-formed sentences had more errors than the anomalous types. It appears unreasonable that the length/type combination which should be the easiest to imitate fails to support the trend. Although, children have been found to respond better to commands above their own level of production (Shipley, Smith, and Gleitman, 1969); responses of children in an imitation task may or may not follow the same pattern. In the present study, the following offers one possible explanation for 75 per cent of the errors: There are six, three-word well-formed sentences, and upon closer examination of these six sentences it was found that, over all, fifty-six errors were made in these sentences. Out of the fifty-six errors, forty-one occurred in the same word in one sentence. The sentence was, "Her doll cries," and the substitution was, "Her dog cries." Further, no other errors occurred in that particular sentence. Due to the characteristics of the consonant cluster llcr ([lk]) in doll cries, and the manner in which such a cluster is coarticulated, it is probable that the point of articulation for the [l] is closer to the point

of articulation for [k]. Thus, the perception of the sound at the end of doll is influenced by the beginning of the word cries. The voiced element of [l] remains, and with the placement of the tongue for [k], the new sound becomes perceived as a [g] (the sound which assimilates some features of both [l] and [k]). This explanation for the effect of coarticulation is supported by the findings of Manning (1972). Generally, the point of articulation of consonant sounds are modified by neighboring sounds in a consonant cluster, whether these clusters occur between words or within words.

Sentence length interacted with functor word types differently than contentive word types. In the case of functors, error rate increased with length, whereas with contentives, error rate showed a marked increase only in seven-word sentences. When sentence length approached and/or exceeded the short-term memory capacity (as may be the case in seven-word sentences), then it appeared that word form was not a differential cue in the retention of words.

The relationship between grade and sentence length suggests a developmental process for short-term memory. Short-term memory capacity imposed greater limits upon first graders than on third and fifth graders. That is, it appears that short-term memory use increased with age. It appears from the data that short-term memory processing

is limited at first grade level, and that a leveling of this processing ability may occur between third and fifth grade. However, further research on seventh and ninth graders would be necessary before it could be determined if a leveling or merely a plateau for the development of short-term memory had been achieved by fifth grade.

Sentence Type

When sentence type, sentence length, and word type were compared (see Figure 2), the interaction between the three variables indicated that sentence type appeared to cause more difficulty than sentence length on the imitation task. The three-word ill-ordered sequence had a higher error rate than the seven-word anomalous types. The same trend existed when sentence type, sentence length, and stress were compared. Since ill-ordered sequences were more difficult to reproduce in this imitation task study, followed by anomalous and well-formed, respectively, then some cues for differential retention of words must come from the sequence structure itself. Since syntactically correct but semantically meaningless sequences were harder to imitate than well-formed types but easier than ill-ordered sequences, then some cues must come from syntactic structures as well as semantic ones. To decide what these cues are, further analysis of the types of errors made, based on order of sequence, would have to be carried out.

Word Type

It would seem reasonable that children rely upon "educated" guessing from context and/or that they learn to expect certain elements of a sentence to be present without having to really process every word separately. Perhaps certain words are perceived from the physical setting rather than the auditory signal. This helps explain why children tend to make more errors on function words than content words. Functors tend to need a specific context in order to be meaningful. There is little difference whether one says "Take the book" or "Take a book" unless there is a specific meaning attached to the sentence by the context in which the sentence is used (i.e., one book on a shelf as opposed to several books on a shelf). This context was not a variable under study in the present investigation. Therefore, the functors were harder to guess. The word take could not be guessed from context, as a choice between leaving the book or taking the book would have to rely on an auditory signal. Book, on the other hand, may or may not be guessed from context. If the only available item in sight were a book, then the word could be guessed from context; but if there were other items on the shelf, such as a cup or a ball, then the word book could not be as easily guessed from context. A reasonable question to ask at this point would be: Is there any differentiating cue made by the speaker when

pronouncing words that cannot be guessed from context? The answer may suggest that stressing plays an important role in this process. If, for example, there was only one book on the shelf, the speaker may have said, "Take the book," with natural stress falling on the word take. If there were a book, a cup, and a ball on the shelf, then the speaker may have said, "Take the book," with primary stress falling on book and secondary stress falling on take. Further research is needed to support this hypothesis.

Stress

Perhaps stress could be put into better perspective by further examination of the interaction between sentence length, word type, and stress (see Figure 5). When stress and word type were compared for all three lengths, functor word types had the highest error rate (two functors were unstressed and one functor was stressed). The lowest error rate occurred on stressed words for all three lengths (two were stressed contentives and one was a stressed functor).

When stress and word type are considered together as shown in Figures 5, 8, and 11, it was found the differences between stressed and unstressed error rates were greater than the differences between contentive and functor error rates. This data was contrary to statements made about word types and stress by Scholes (1970). It was apparent that the differences in error rate were greater

between stressed and unstressed words within the same sequence length and sequence type than the error rate between contentives and functors for the same sequence length and sequence type. This data indicated, then, that stress was primary to word form as a basis for differential retention of words.

The interaction of sentence type and word type (see Figure 9) as compared with the interaction of sentence type and stressing (see Figure 11) further supported the contention that stressing played a more important part than word type, at least in the present imitation task. The error rate difference between functors and contentives was less than the difference between stressed and unstressed words. The greatest difference in error rate for stressed and unstressed words occurred in ill-ordered sequences and in seven-word length sentences. It was at these points that stress appeared to serve their most important function in the retention ability of the subjects. When short-term memory had been exceeded (increased sentence length) and task difficulty increased (ill-ordered sequence types), as indicated by an over-all increase in error rate, the error rate differences between stressed and unstressed words were the greatest. This would seem to indicate that stress played a role in the retention ability of the subjects for non-normal sentences. In first language learning, children deal with adult models which usually

exceed the child's memory span. It seems reasonable that stress would also aid the child in the reduction of the adult model (Brown and Bellugi, 1964). Stress may not, however, have a significant function in well-formed sentences (Lieberman, 1965).

Grade Level

When interactions involving grade level were examined, the only exception to the trend occurred in anomalous sentence types than did third graders. Perhaps fifth graders recognized the syntactic correctness of anomalous sentences and tried to make them more well-formed. anomalous sentences and tried to make them more well-formed.

Implications for Therapy and Future Research

As the data showed, stress was an important cue in the retention of words on the present imitation task study. Therapy, making use of imitation techniques, should include the use of stress in its program to help cue individuals to remember and produce words usually deleted or in error.

Further research should be conducted in clinical settings to see whether or not language and speech habilitation programs which make conscious use of stress as a cue in correction and expansion models of therapy are successful in increasing short-term memory span. Further, the role of stress in improvement of speech and language production should be examined.

Implications for therapy and for the classroom teacher arise from the first grade limitation on short-term memory. It seems that in any learning task, the child is only processing shorter units effectively. This may explain why it is so difficult for first graders to "follow directions" and why many first grade teachers devote the whole year to this task. If a child is limited in his processing of longer sequences, then it may follow that with repetition, the child can eventually acquire the meaning out of the longer sentence, particularly if there is a way of directing his attention to the words he missed on preceding trials.

Results of grade level trends indicated a need for future research including seventh and ninth grade levels in this present study. Although the error rate differences of third and fifth graders were minimal, the general trend for error rate to decrease as grade level increased was still visible. This leveling of error rate needs to be further stabilized before statements can be made about the processing abilities and differential retention abilities of third and fifth graders as compared to the adults' abilities.

The area of mental retardation is in great need of some guidance in the area of speech and language programs. This present study should be carried out with a population of mentally retarded to see how the trends develop. A

comparison should be made between the trends found in the normal population and the trends depicted by the mentally retarded population. If similar patterns emerged, then programs for the retarded could parallel regular language programs. If, however, the trends were non-existent or very different from the normal population, then language programs for the mentally retarded should be based on cues which aid the retarded individual's optimal retention behavior. The results of the present study (if presented to a mentally retarded population) may yield implications for therapy or may only yield implications for further research. In either case, something definite could be said about the mentally retarded population with regard to short-term memory and differential cues utilized in imitation behavior as affected by mental age. This in itself would contribute considerably to the literature in the area of mental retardation and language development.

Implications for Further Analysis of Present Data

In order to obtain trends for the interactions of the variables under study, it was necessary to score words as either correct or incorrect. However, information about type of phonetic, phonemic, syntactic, and semantic misperception could very probably be gleaned from further analysis of the various substitution and deletion errors. For example, information regarding the development of the

phonological rule for plurals could be obtained by analysis of the words where the plural case was changed by the subjects. The same type of analysis could be conducted for coarticulation effects, comparing universal sound segments with non-universal sound segments, order errors in relationship to syntax especially in ill-ordered sentence types, and word substitutions in relationship to semantics in anomalous sentence types. Phonetic features of sound substitutions could be compared with those of the sounds they replaced to see if the distinctive features were modified.

CHAPTER V

CONCLUSION

The results of this study, as demonstrated by the subject's differential retention of words in a sentence imitation task indicated that sentence length, sentence type, word type, stress, and grade level of the child did interact at various levels.

The results showed that error rate increased as sentence length increased. Further, ill-ordered sequences had greater error rates than anomalous and well-formed types, respectively. The main effect for word type indicated that a higher percentage of errors occurred on functor word types more than on contentive word types. The effect for stress indicated that unstressed words had greater error rates than stressed words. Finally, error rate decreased as grade level increased.

Exceptions to these trends occurred when interactions between sentence length and sentence type were examined. Ill-ordered sequences had higher error rates at all lengths than any other length-type combination. Another exception to the trend involving sentence length

and sentence type was found in three-word well-formed sequences where upon closer examination, it appeared that coarticulation might have played an important role in the processing of that length-type combination.

Sentence type interacted with grade level where fifth graders made more errors on anomalous sequences than on ill-ordered sequences.

Interactions involving word type and stress indicated that in ill-ordered and well-formed sequences, stressed functor error rates were higher than unstressed functor error rates. Further, unstressed contentive error rates were higher than stressed error rates.

Results of grade level trends indicated a need for further research. Although the error rate differences of third and fifth graders were minimal, the general trend for continued decreasing error rates needs to be stabilized by testing the recall ability of seventh and ninth graders on this present imitation task study.

LIST OF REFERENCES

Aaronson, D. "Temporal Factors in Perception and Short-Term Memory." Psychological Bulletin, LXVII (1967), 130-44.

Beasley, D., and Acker, J. "The Effect of Sentence Length, Sentence Type, Word Type and Stress on Four and Five Year Olds." Unpublished study, Michigan State University, 1971.

Blasdell, R., and Jensen, P. "Stress and Word-Postion as Determinants of Imitation in First-Language Learners." Journal of Speech and Hearing Research, XIII (1970).

Broadbent, D. "A Mechanical Model for Human Attention and Immediate Memory." Psychological Review, LXIV (1957), 205-15.

Brown and Bellugi. "Three Processes in the Child's Acquisition of Syntax." Harvard Educational Review, XXXIV (1964), 133-51.

Chomsky, N., and Halle, M. The Sound Pattern of English. New York: Harper and Row, 1968.

Fry, D. B. "Duration and Intensity as Physical Correlates of Linguistic Stress." Journal of the Acoustical Society of America, XXVII, No. 4 (1955), 765-69.

Lieberman, P. "On the Acoustic Basis of the Perception of Intonation by Linguists." Word, XXI, No. 1 (1965), 40-54.

Manning, W. H. "Coarticulation as an Adjunct to Speech Perception." Unpublished study, Michigan State University, 1972.

Martin, J. "Temporal Word Spacing and the Perception of Ordinary, Anomalous, and Scrambled Strings." Journal of Verbal Learning and Verbal Behavior, IX (1970), 167-70.

Menyuk, P. "A Preliminary Evaluation of Grammatical Capacity in Children." Journal of Verbal Learning and Verbal Behavior, II (1963), 429-39.

Miller, G. "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information." Psychological Review, LXIII (1956), 81-97.

Pollack, I. "Message Uncertainty and Message Reception." Journal of the Acoustical Society of America, XXXI (1959), 1500-08.

Scholes, R. "On Functors and Contentives in Children's Imitations of Word Strings." Journal of Verbal Learning and Verbal Behavior, IX (1970), 167-70.

Schuckers, G.; Shriner, T.; and Daniloff, R. "Auditory Reassembly of Segmented Sentences by Children." Submitted to Journal of Speech and Hearing Research, (1971).

Shipley, Smith, and Gleitman. "A Study in the Acquisition of Language." Language, XLV, No. 2 (1969), 332-42.

Sperling, G. "A Model for Visual Memory Tasks." Human Factors, V (1963), 19-31.

APPENDICES

APPENDIX A

SENTENCES LISTED ACCORDING TO SENTENCE TYPE

APPENDIX A

SENTENCES LISTED ACCORDING TO SENTENCE TYPE

Well-Formed

My mother washes the dishes.
My dog runs.
The boy plays.
Her doll cries.
The little boy pulls his red wagon.
His brother climbs a tree.
My black dog likes the new bone.
Her big sister wants a new dress.
The pretty teacher reads a funny story.
The other girl lost her blue ball.
Your father drives a car.
Take the book.
The boy rides a bike.
Wash your face.
My cat drinks the milk.
Throw the ball.
The old man takes a long walk.
The girl wears a hat.

Ill-Ordered

His purrs cat.
Eats bear the fresh honey the brown.
Man dirty nice cleans shoes the his.
Balloon happy the clown carries funny a.
Hits car train the a.
My bring bike.
Milk spills the.
Choose friend a.
Door close the.
Carrot the bunny eats the.
Kitten chases my her dog.
Covers blanket baby the yellow the bed.
Washes a the man big green car.

Spins toy your.
Brings a flowers lady the.
Baby his calls the mother.
Sister my the spills water.
Girl red cow silly draws the a.

Anomalous

The tall tree washes the dirty dog.
The chair flies.
My yellow dress cries a large tear.
Her big brother sings his black shoe.
Read a paint.
Drink the table.
An airplane chops the wood.
The dog purrs his bone.
A leaf walks.
Comb your teeth.
A nice man wears his new horse.
Her bike eats an apple.
The happy children drink a green spoon.
The tree hops.
His sister bakes a book.
The pretty picture colors a little boy.
The chair plays a drum.
The lady walks her coat.

APPENDIX B

SENTENCES CHANGED FROM ORIGINAL TAPE USED BY BEASLEY AND ACKER

APPENDIX B

SENTENCES CHANGED FROM ORIGINAL TAPE USED BY BEASLEY AND ACKER

Sentence Number 20

Was: Write letter a.

Changed to: Choose friend a.

Sentence Number 34

Was: A bird bounces.

Changed to: A leaf walks.

Sentence Number 44

Was: The fish hops.

Changed to: The tree hops.

APPENDIX C

RANDOMIZATION OF SENTENCE TYPE, SENTENCE LENGTH, AND STRESS

APPENDIX C

RANDOMIZATION OF SENTENCE TYPE, SENTENCE LENGTH, AND STRESS

Sentence Type	No. of the Sentence
Well-Formed	1, 4, 5, 6, 9, 17, 18, 23, 25, 30, 35, 36, 39, 45, 46, 50, 53, 54.
Ill-Ordered	2, 10, 11, 14, 15, 16, 19, 20, 21, 22, 26, 27, 28, 29, 31, 37, 38, 52.
Anomalous	2, 6, 8, 12, 13, 24, 32, 33, 34, 40, 41, 42, 43, 44, 47, 48, 49, 51.
Sentence Length	
Three-Word	2, 4, 6, 7, 9, 13, 16, 19, 20, 21, 24, 29, 34, 39, 40, 44, 46, 53.
Five-Word	1, 5, 15, 18, 22, 26, 31, 33, 36, 37, 38, 42, 45, 47, 49, 50, 51.
Seven-Word	3, 8, 10, 11, 12, 14, 17, 23, 25, 27, 28, 30, 35, 41, 43, 48, 52, 54.
Stressing	
Contentives Stressed	2, 7, 10, 13, 14, 18, 21, 23, 26, 36, 37, 39, 42, 43, 44, 48, 49, 54.
Functors Stressed	1, 3, 5, 9, 15, 16, 24, 28, 30, 34, 35, 38, 41, 46, 47, 51, 52.
No Stress	4, 6, 8, 11, 12, 17, 19, 20, 22, 25, 27, 29, 31, 32, 33, 40, 45, 50, 53.

APPENDIX D

INSTRUCTIONS GIVEN TO SUBJECTS

APPENDIX D

INSTRUCTIONS GIVEN TO SUBJECTS

I want you to listen to what the man is saying on the tape recorder and then tell me exactly what you heard him say. If you can't remember everything, tell me as much of it as you can. For example, if the man said, "He likes food," what would you say? _____. Good! Let's try another. If the man said, "Find go him," what would you say? _____. Good! Let's do one more. If the man said, "The door plays," what would you say? _____. Fine, let's begin.

APPENDIX E

ANSWER FORM USED TO TRANSCRIBE SUBJECTS' RESPONSES

APPENDIX E

ANSWER FORM USED TO TRANSCRIBE SUBJECTS' RESPONSES

NAME_____S#____GRADE____TEACHER_____AGE___YRS.___MOS.

PRACTICE ITEMS: That girl eats. Is big she. The desk talks.

1. My mother washes the dishes.
2. His purrs cat.
3. The tall tree washes the dirty dog.
4. My dog runs.
5. The girl wears a hat.
6. The chair flies.
7. The boy plays.
8. My yellow dress cries a large tear.
9. Her doll cries.
10. Eats bear the fresh honey the brown.
11. Man dirty nice cleans shoes the his.
12. Her big brother sings his black shoe.
13. Read a paint.
14. Balloon happy the clown carried funny a.
15. Hits car train the a.
16. My bring bike.
17. The little boy pulls his red wagon.
18. His brother climbs a tree.
19. Milk spills the.
20. Choose friend a.
21. Door close the.
22. Carrot the bunny eats the.
23. My black dog likes the new bone.
24. Drink the table.
25. His big sister wants a new dress.
26. Kitten chases my her dog.
27. Covers blanket baby the yellow the bed.
28. Washes a the man big green car.
29. Spins toy your.
30. The pretty teacher reads a funny story.
31. Brings a flowers lady the.
32. An airplane chops the wood.
33. The dog purrs his bone.
34. A leaf walks.
35. The other girl lost her blue ball.
36. Your father drives a car.
37. Baby his calls the mother.
38. Sister my the spills water.
39. Take the book.
40. Comb your teeth.
41. A nice man wears his new horse.
42. Her bike eats an apple.
43. The happy children drink a green spoon.
44. The tree hops.
45. The boy rides a bike.
46. Wash your face.
47. His sister bakes a book.
48. The pretty picture colors a little boy.
49. The chair plays a drum.
50. My cat drinks the milk.
51. The lady walks her coat.
52. Girl red cow silly draws the a.
53. Throw the ball.
54. The old man takes a long walk.

APPENDIX F

TABLES OF MEAN PERCENTAGE ERROR SCORES

TABLE 2.--Mean Percentage Error Scores for Well-Formed Sentences by Grade (first grade, third grade, fifth grade), Word Type (functors and contentives), Sentence Length (three words long, five words long, seven words long), and Stress (stressed and unstressed).

Word Type	Length	First Grade			Third Grade			Fifth Grade			Total
		Stressed	Unstressed	Joint	Stressed	Unstressed	Joint	Stressed	Unstressed	Joint	
Functors	3	3.3	0.8	2.1	0.0	2.5	1.3	1.7	0.0	0.9	1.4
	5	0.0	2.3	1.2	3.3	1.7	2.5	1.7	1.3	1.5	1.7
	7	10.0	4.3	7.2	1.7	1.3	1.5	3.3	1.7	2.5	3.7
	Joint	4.4	2.5	3.5	1.7	1.8	1.8	2.2	1.0	1.6	2.3
Contentives	3	0.0	6.0	3.0	0.0	4.7	2.4	0.0	4.3	2.2	2.5
	5	0.0	0.0	0.0	0.0	0.6	0.3	0.0	0.0	0.0	.1
	7	6.7	6.3	6.5	0.0	1.4	0.7	0.0	1.1	0.6	2.6
	Joint	2.2	4.1	3.2	0.0	2.2	1.1	0.0	1.8	0.9	1.7
	Total	3.3	3.3		0.8	2.0		1.1	1.4		2.0

TABLE 3.--Mean Percentage Error Scores for Anomalous Sentences by Grade (first grade, third grade, fifth grade), Word Type (functors and contentives), Sentence Length (three words long, five words long, seven words long), and Stress (stressed and unstressed).

Word Type	Length	First Grade			Third Grade			Fifth Grade			Total
		Stressed	Unstressed	Joint	Stressed	Unstressed	Joint	Stressed	Unstressed	Joint	
Functors	3	1.7	1.7	1.7	3.3	1.7	2.5	1.7	1.7	1.7	2.0
	5	5.0	11.3	8.2	6.7	4.0	5.4	8.3	5.3	6.8	6.8
	7	6.7	12.3	9.5	0.0	7.3	3.7	1.7	6.0	3.9	5.7
	Joint	4.5	8.4	6.5	3.3	4.3	3.8	3.9	4.3	4.1	4.8
Contentives	3	5.0	1.0	3.0	1.7	0.7	1.2	5.0	2.0	3.5	2.6
	5	0.0	3.1	1.6	0.0	1.5	0.8	0.0	2.3	1.2	1.2
	7	5.0	12.9	9.0	0.0	5.4	2.7	0.0	5.6	2.8	4.8
	Joint	3.3	5.7	4.5	0.6	2.5	1.6	1.7	3.3	2.5	2.9
	Total	3.9	7.1		2.0	3.4		2.8	3.8		3.8

TABLE 4.--Mean Percentage Error Scores for Ill-Ordered Sentences by Grade (first grade, third grade, fifth grade), Word Type (functors and contentives), Sentence Length (three words long, five words long, seven words long), and Stress (stressed and unstressed).

Word Type	Length	First Grade			Third Grade			Fifth Grade			Total
		Stressed	Unstressed	Joint	Stressed	Unstressed	Joint	Stressed	Unstressed	Joint	
Functors	3	0.0	16.0	8.0	3.3	8.7	6.0	0.0	4.7	2.4	5.5
	5	18.3	18.7	18.5	8.3	9.0	8.7	3.3	8.7	6.0	11.1
	7	43.3	42.3	42.8	45.0	27.0	36.0	30.0	17.0	23.5	34.1
	Joint	20.5	25.7	23.1	18.9	14.9	16.9	11.1	10.1	10.6	16.9
Contentives	3	11.7	10.3	11.0	0.0	1.3	0.7	3.3	3.3	3.3	5.0
	5	3.3	12.7	8.0	0.0	7.5	3.8	0.0	7.5	3.8	5.2
	7	30.0	36.7	33.4	16.7	27.9	22.3	10.0	16.2	13.1	23.0
	Joint	14.8	20.0	17.4	5.6	12.2	8.9	4.4	9.0	6.7	11.0
	Total	17.7	22.9		12.3	13.6		7.8	9.6		14.0

APPENDIX G

COMPUTATION PROCEDURES

APPENDIX G

COMPUTATION PROCEDURES

Computation procedures for per cent error scores were made as follows: Every word was classified as either a stressed contentive, a stressed functor, an unstressed contentive, or an unstressed functor. The total number of word-type/stress combinations for each sentence type, sentence length, and grade level, respectively, was divided into the number of errors made in each condition of stress and word-type. From this came the percentage error scores.