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THE INFLUENCE OF SENTENCE LENGTH AND SENTENCE STRUCTURE ON ELICITED IMITATION IN PRE-SCHOOL CHILDREN

by

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CHAPTER I

THE PROBLEM

Background of the Problem

Language development in children has been the focus of much research for the past fifty years. Early research had taken the form of longitudinal naturalistic diary accounts of one or two children (see for example, Jespersen, 1922; Nice, 1925; Smith, 1933, 1935; Davis, 1937; Young, 1941; Lewis, 1957; Templin, 1957). This research had analyzed speech sound development; it had counted the number of words in children's active and passive vocabularies; and it had analyzed the types of words used according to traditional part-of-speech methods. A number of studies had used mean length of response both as a way to analyze linguistic skills and as a predictor of language development.

The direction of research then changed. Linguistic theory and the growth of the field of psycholinguistics changed the focus of study to the child's development of syntactic, semantic, and phonological competence. Investigators began to use the actual responses of the child (his linguistic performance) to understand what he knows about his language (his linguistic competence). This new approach

led to descriptive and experimental studies of children and adults in attempts to describe the processes involved in understanding and creating sentences. Approaches to the problem have included perceptual studies, analyses of recall of various types of syntactic material, and investigations concerning the types and amounts of linguistic material which, when varied phonologically, morphologically, syntactically, or semantically, children and adults are able to repeat, comprehend, or learn.

Analysis of a sentence presumably involves recovery of the structural description of the sentence. This theoretical structural representation of the sentence indicates its various syntactic relations (Garrett and Fodor, 1968). A great deal of recent research has sought to establish the psychological reality of various linguistic operations, as well as to show correspondence between formal linguistic features and various psychological behaviors, such as perception, learning, and comprehension of the linguistic features.

The study of verbal behavior in children and adults relies heavily on both theoretical formulations of linguistics and the behavioral applications of psychology. Chomsky's grammatical theory gave linguists and psychologists a new framework in which to analyze both the speaker-hearer's knowledge of his language and his ability to realize this competence in actual linguistic performance. As Garrett and Fodor (1968) have indicated, the problem for

psycholinguistic theory (and research) is to explain how a speaker uses his competence in linguistic performance.

The literature has presented various accounts of grammatical learning, including association models and information theory, most of which go beyond the scope of this paper. The formulation to be emphasized here is a generative model as postulated by Chomsky (1957, 1965) and others (see for example Miller, 1962; Bever, 1968).

The generative model basically includes a phrase structure grammar which generates a base structure of components on which transformational rules operate to derive the surface structure. The simplest sentence, derived from the abstract notion of the kernel sentence, is a simple, active, affirmative, declarative sentence and includes only obligatory transformations in its derivation. The transformational history of a sentence, the number of operations needed to generate the surface structure, and the amount of disparity between the deep and surface representations of a sentence give some notion of the syntactic and semantic complexity of the sentence.

There have been many changes in Chomsky's original (1957) formulations in order to deal most effectively with the regularities and irregularities of English grammar. A recent analysis of the passive construction, for example, views this form as being derived directly from deep structure rather than as a result of a specific passive transformation. Hasegawa (1968) feels that it is more efficient,

and will more adequately account for all cases of passive construction, to consider the passive form as a special case of the verb complement construction and to derive it directly by an obligatory transformation from deep structure.

The literature has also presented deep and surface structure models of the relationships among sentence types and the ways to characterize sentence complexity.

One of the major surface structure approaches is that of Yngve (1960). This model consists of left-to-right sequence rules operating in a phrase structure or immediate constituent framework. Yngve (1960) assumes that phrase structure can be used as the basis for the model and that the model should share with human speakers the knowledge that words are produced one at a time in the proper time sequence, that is, in left-to-right order.

This model contains four parts: an output device which prints symbols one at a time in left-to-right fashion; a computing register capable of holding one symbol at a time; a permanent memory in which the grammatical rules are stored; and a temporary memory in which the immediate results are stored (Yngve, 1960). The rules are applied by expansion, with the leftmost constituent always expanded first and the constituents waiting to be expanded stored in temporary memory. The output sequence of the mechanism represents not only the sentence but its constituent structure as well. The order of symbols in the output is the

order in which the nodes of the tree enter the computing register. This means expanding the left member of every constituent first and when the end of a branch is reached retracing it to the next higher unexpanded right-hand member.

Yngve (1960) states that although the number of rules is finite, this device has the desired property of producing any sentence of an infinite set since certain rules can be reapplied along the same branch during production of a sentence. The complexity of sentences, according to this model is determined by computing the number of nodes (branches) that lead to each terminal node of the surface structure tree diagram. The total average of all these distances is the mean depth of the sentence, which is a measure of both sentence complexity and the amount of temporary storage space needed to produce the sentence (Yngve, 1960).

The model of Yngve (1960) has the advantage of handling analysis of English grammar as well as operating within the limits of immediate memory span. Studies using this model have shown that while the model was able to account for a portion of the results, there was a need to include deep structure and/or transformational analysis of the material in order to explain adequately the way subjects process nonsense material, word classes, and complex sentences. The model also appears to be particularly inefficient in

handling semantic analysis of sentences and in solving ambiguities in surface structure which can be satisfactorily solved by deep structure analysis.

A view of sentence generation and sentence complexity operating within the framework of Chomsky's generative approach is that of George Miller (1962). Grammar, according to Miller (1962), is the psychological foundation for the combinatorial power of language. It involves the arrangement of symbols in a novel and useful way. Generative grammar is defined by Miller (1962) as a way to deal with the constituent structure of a sentence by applying rules of formation which permit the rewriting of a basic axiom until the desired sentence is derived.

Miller's (1962) presentation of the relationship among sentences and of sentence complexity, known as the "recoding" or "coding" hypothesis, is the basis for the hypothesis that speaker-hearers of a language use a system for producing complex sentences from simple, active, affirmative, declarative (SAAD) sentences in which the simple sentence is stored in memory with additional footnotes about further syntactic structure. Miller (1962) feels that the kernel (SAAD) sentence is the level represented in memory. Other types of sentences, such as N, PQ, NPQ, are remembered by supplementing the memory of the kernel sentence with a footnote about additional syntactic structure.

Miller's (1962) model represents the relationships between the kernel sentence, containing only obligatory transformations, and those formed by the addition of the optional transformations of negative, passive, question, and all combinations of these transformations. He views the kernel (SAAD) sentence as the simplest containing no additional footnotes for recoding syntactic structure. Passive (P), negative (N), and question (Q) sentences are next in complexity since each involves only one footnote to the simple sentence in order to transform it. Negative-passive (NP), negative-question (NQ), and passive-question (PQ) are more complex in that each involves adding the combination of two transformations to generate the sentence. The most complex sentence type in Miller's (1962) model is the negative-passive-question (NPQ) in that three operations are needed to transform the SAAD sentence into its final form.

Although George Miller's formulation only deals with the relationship of seven transformations to the kernel form and to each other, it clearly expresses a relationship of deep and surface structure. The recoding hypothesis presents a possible explanation about the way complex sentence types are stored and processed, an explanation which has largely been supported by experimental data.

The Present Problem

In 1969, Slobin stated that "a major advance with age is the increasing ability to program longer and more

complex utterances" (Slobin, 1969, p. 10) and that "increasing sentence-programming span appears to be one major determinant of the growth in linguistic complexity with age" (Slobin, 1969, p. 11). Chomsky, in a formal discussion of a paper by Wick Miller and Susan Ervin, pointed out that "the child's ability to repeat sentences and non-sentences . . . might provide some evidence as to the underlying system he is using" (Chomsky, 1964, p. 39).

Elicited imitation has been used by a number of investigators as a technique for assessing a child's linguistic competence (for example, Brown and Fraser, 1963; Menyuk, 1963b, 1964a, 1965, 1969; Salzinger, Salzinger and Hobson, 1966; Slobin, 1967, 1968a; Slobin and Welsh, 1968). These studies, and others to be discussed, present results on children's ability to correctly repeat adult sentences, as well as results on the kinds of errors children make in their attempts to imitate the target sentences. These investigators recognize the importance of the child's sentence programming span in determining the ability to correctly repeat the given sentence. None of the previous studies controlled the length of sentence nor systematically varied the type of sentence the children were asked to repeat. It is therefore difficult to determine whether it was the length of the sentence, the grammatical complexity of the sentence, or a combination of these factors which facilitated or interfered with the child's exact replication of a given sentence.

Purpose of the Study

The purpose of the present study is to analyze children's elicited imitations of target sentences which have been controlled for both sentence length and sentence complexity. The study will attempt to determine the interaction of sentence structure with the child's sentence programming span, that is, the relationship of children's ability to recall sentential material of varying lengths to his ability to deal with the grammatical structure of those sentences.

Definitions of Terms

For the purposes of this study, the following definitions of terms will be used:

Sentence length is defined in terms of the number of words in the sentence.

Sentence complexity is defined by the relationships of the seven types of complex sentences to SAAD sentences as postulated by George Miller (1962). SAAD sentences will be called Level 0 complexity; P, N, and Q sentences will be called Level 1 complexity; NP, NQ, and PQ sentences will be called Level 2 complexity; and NPQ sentences will be called Level 3 complexity.

Word is defined as: ". . . any linguistic form considered to be independent in distribution and meaning and capable of being written with space on either side" (Francis, 1958, p. 597).

Hypotheses to be Tested

This study will test the following hypotheses:

H_1: When sentence length is held constant, children's ability to repeat sentences correctly will decrease as sentence complexity increases;

H_2: When grammatical complexity is held constant, children's ability to repeat sentences correctly will decrease as sentence length increases;

H_3: Grammatical complexity will exert greater influence than sentence length on children's ability to correctly repeat sentences;

H_4: The influence of grammatical complexity will be shown as a hierarchical structure with more correct repetitions at:

a. Level 0 than Levels 1, 2, or 3
b. Level 1 than Levels 2 or 3
c. Level 2 than Level 3;

H_5: Length of sentence children can correctly repeat will increase with age;

H_6: Complexity of sentence children can correctly repeat will increase with age.

From information bearing on these hypotheses, inferences about children's linguistic competence and the strategies they use in processing sentences can be drawn.

CHAPTER II

RELATED LITERATURE

The purpose of this chapter is to present a review of the literature pertaining to the acquisition, development, and usage of language with emphasis on the development of syntactic structures. Theoretical formulations and results of descriptive and experimental studies with both children and adults will be presented.

Studies of Linguistic Behavior in Adults

Studies of linguistic behavior using adult subjects have explored syntactic competence and performance relating to both deep and surface structure. These studies attempt to demonstrate that grammatical structure has an effect on perception, learning, recall, and comprehension of various linguistic units. The majority of these studies analyze the results within the framework of a transformational grammar model, attempting to show differential effects of deep and surface structure. Several studies interpret findings in terms of surface structure alone, either by sequential probabilities analysis or by the depth measure of Yngve.

Although the concern of the present investigation is with the development of linguistic skills in children, the adult studies have made important contributions in two major areas. The adult studies have accumulated data which encouraged the formulation of hypotheses about the ways speakers of a language perceive, learn, recall, and comprehend aspects of their linguistic system. These hypotheses have allowed for inferences to be made about the way children develop the same skills. The adult studies have also presented experimental designs which are often ingenious and which can be modified and/or simplified so that the procedure might be used with a child population.

The results of the studies using adult populations lead this reviewer to concur with the interpretation Thomas Bever has given for the reported results. He interprets the behaviors shown on different psychological tasks as

> . . . the consequence of a general "kernalization" routine in the psychological manipulation of sentences. As a strategy it is stated: Reduce sentential material to simple declarative sentences. This routine applies to the surface structure of the sentences or to the deep structure, depending on the psychological task. (Bever, 1968, p. 492)

The studies on linguistic behavior in adults have analyzed many aspects of the problem. Studies at the word level, including word association studies, investigations of phonological and morphological performance and competence, and investigations concerned with surface structure analysis have all presented interesting insights into aspects of linguistic behavior.

Since the concern of this present study is with linguistic skills in children, the review of the extensive adult literature must be brief. The following pages will show the types of studies and major results found using adult subjects. The emphasis will be on those investigations which focus on how adults process sentential material, on the strategies they use in dealing with complex syntactic material, and on investigations based on transformational theory and relevant to Miller's (1962) coding hypothesis. Such adult studies are particularly important because the present study uses transformational theory and the coding hypothesis as the basis for analyzing linguistic skills in children.

The Effects of Grammatical Structure on Perception

Several investigations have shown that the perception of continuous speech material involves segmenting it into sentence groups.

Fodor and Bever (1965) and Garrett, Bever, and Fodor (1966) showed that the location of clicks within sentences are perceived as occurring around a major syntactic boundary within the sentence. Mehler and Carey (1967) found that surface structure influences the perception of sentences. Preliminary results of Mehler and Fodor (reported by Garrett and Fodor, 1968) indicate that deep structure affects perception as well. These findings are supported by

the conclusions of Miller and Isard (1963) and of Compton (1967). Compton (1967) found that SAAD sentences, being closest to the kernel form, are most intelligible with decreasing order of intelligibility for P, N, Q, PN, and NPQ sentences.

The studies on perception of grammatical structure indicate that the farther away a given sentence is from its kernel form, either in terms of grammaticality or number of additional optional transformations, the greater the perceptual difficulty of the sentence. These studies also show that sentence perception is an active process in which structural analysis of the sentence facilitates this processing.

The Effect of Grammatical Structure on Learning

A number of studies have shown that grammatical structure facilitates learning of various types of sentential material.

Using strings which violated syntactic and/or semantic rules, Marks and Miller (1964) found that the strings most easily learned are those which contain fewest errors. Similar results were found by Epstein (1961, 1962) in that syntactically structured strings are learned in fewer trials than unstructured strings.

Studies by Glanzer (1962), Simpson (1965), Coleman (1965b), and Foster (1966) confirm the facilitating effect

of syntax on learning. Dunn (1968) did not find this effect using nonsense material. The general findings of these studies, however, indicate that the closer the material to be learned is to correct syntactical form the faster it is learned. The studies also suggest that subjects may adopt different strategies in learning different types of syntactic material. The facilitating effect of syntax on learning strings of words which may or may not be real words or follow standard syntax appears to be dependent upon the meaningfulness of the string, its approximation to normal sentence word order, and upon the interaction of syntactic and semantic attributes of the strings as they approach grammaticality.

The effect of syntax on learning different types of sentences has also been demonstrated. Studies by Coleman (1965a), Prentice (1966), and Epstein (1967) found that active constructions are easier to learn than passive constructions. Nominalizations were found to be difficult to learn (Coleman, 1965a; Epstein, 1967). Coleman (1965a) also showed that non-embedded sentences are easier to learn than embedded sentences. Downey and Hakes (1968) showed that learning sentences which violate phrase structure rules is more difficult than learning sentences which violate either strict categorization rules or selectional restrictions and that learning sentences with no rule violations is easiest.

These studies of the effect of grammatical structure on learning show that learning is facilitated in proportion to its grammaticality, when the material is in the active rather than the passive form, and when the material does not violate the deep structure rules of the sentence. It appears that learning is easier for sentences nearer the underlying kernel form.

Sentence Processing Strategies and the Coding Hypothesis

The coding hypothesis of George Miller (1962) was tested in studies attempting to determine the strategies adults use in processing sentential material. The approach used by the majority of these investigators was to determine the amount of time needed to process different transformations, on the assumption that more time is needed to process more complex material.

Miller, McKean, and Slobin (reported by Miller, 1962) and Miller and McKean (1964) studied the amount of time needed to match kernel sentences to N, P, and PN transformations of the kernels. These investigators found that subjects take similar amounts of time to match kernel to N and P forms as they do to match PN to P or N forms. More time is needed to match kernel to PN and N to P. The order of sentence matching from shortest to longest time needed is: K or P to N, K to P, PN to N, K to PN, N to P. These studies also found that the processing time needed for the

different sentence types is additive. That is, the time needed to process a sentence containing two transformations is approximately the same as the sum of each transformation applied separately. Miller and McKean (1964) performed a similar matching experiment using three verb constructions which involved adding either the auxiliary verb "be," "had," or both "be" and "had" to the kernel sentence. They found that these differences are dealt with more rapidly than the affirmative-negative and active-passive differences. The time required to process the two syntactic differences in verb construction is not additive.

These results strongly support the coding hypothesis and indicate that the number of steps in the derivational history of a sentence is a valid index of complexity. The lack of significant differences in terms of verb changes may be an indication that these sentences are actually kernel sentences (having no optional transformations in their derivation). As Bever (1968) pointed out, the affix-movement transformation is the only one needed to derive sentences with auxiliaries and this transformation is also used to derive simple declarative sentences. The above results also strongly support the view that interpretation or production of every sentence requires a complete syntactic analysis and that affirmative active sentences are syntactically simpler, requiring less time in analysis. As Miller and McKean state:

> This is, in essence, what a transformational theory says: P, N, and PN sentences contain all the same syntactic rules as do active affirmative sentences, plus one to two more which increase their complexity and require a little more time for interpretation (and production). (Miller and McKean, 1964, p. 307)

Using a different approach, Mehler (1963, 1964 reported by Garrett and Fodor, 1968) confirmed the results of Miller and McKean (1964). Mehler (1963) used eight sentence types (SAAD, Q, P, N, PQ, NQ, PN, NPQ) and had subjects recall sets of sentences. He found that SAAD sentences are easiest to learn and recall and that sentence length cannot predict ease of learning. The errors made in recall show a strong tendency to reduce sentences to the simplest form which preserves semantic content.

The results of Savin and Perchonock (1965) also support the coding hypothesis and confirm the previous findings. These authors used a different experimental approach which related the memory storage requirements of various sentence types to their derivational history. They hypothesized that the greater the complexity of the sentence (number of rules required for its derivation) the greater would be the demands on storage space in memory. Subjects were required to recall both a sentence and a set of unrelated words where the number of words recalled was the measure of memory space needed for that sentence type. In every case, sentences involving one optional transformation require less memory space than those involving two

transformations and SAAD sentences cause the least interference with word recall (Savin and Perchonock, 1965).

Several other studies demonstrated that deep structure and derivational history facilitate recall. Savin (reported by Wales and Marshall, 1966) found that recall of right-branching sentences is more accurate than recall of similar self-embedded sentences. Using a technique of prompted recall, where a word from the sentence is given as a cue to recalling the entire sentence, Blumenthal (1967) and Blumenthal and Boakes (1967) found better recall scores when the prompt word relates to the underlying grammatical relations of the sentence. Clifton, Kurcz, and Jenkins (1965) also showed the importance of transformational relationships in that sentences exhibiting similar derivational histories were found to be confused with each other more often than sentences not showing this relationship.

The results of studies by Wright (1968), Matthews (1968), and Epstein (1969), using modifications of the technique of Savin and Perchonock (1965), generally support the previous findings but point out conditions under which they are not confirmed. Wright (1968) found that similarity in sentence frames and sentence types in the set to be learned or recalled eliminates differences between simple and complex sentences. Matthews (1968) found that recall conditions (immediate or delayed) and addition of adjectives to increase sentence length affect ease of recalling different

sentence types. Epstein (1969) found that recall is influenced by the type of preceding string and that string recall interferes with list recall.

Studies by Bregman and Strasberg (1968) and by Bever and Mehler (reported by Fodor and Garrett, 1966) failed to find direct interaction between ease of short-term recall and length of derivational history. Both of these investigations emphasize the importance of differences in memory for different types of syntactic material and indicate that these memories are reflected in the way the sentences are understood or recalled. The conclusions of both of these studies suggest that basic syntactic form is preserved in memory, but that syntactic complexity, semantic content, length of recall time, intervening tasks, and the specific response required of the subject, affect the results.

Goldman-Eisler and Cohen (1970) suggest, however, that differences found in processing SAAD, N, P, and PN sentences are not a valid measure of the psychological reality of transformational theory. Based on samples of spontaneous speech of adult speakers under different circumstances, Goldman-Eisler and Cohen (1970) found that 80% to 90% of verbal forms are SAAD sentences, negatives constitute 4% to 10%, passives 7% to 10%, and PN sentences rarely occur. Thus the authors suggest that any results based on the relationship between these sentence types is misleading because of the significantly greater amount of practice with

and exposure to SAAD sentences adult speakers have. Goldman-Eisler and Cohen (1970) accept the kernalization strategy as presented by Chomsky (1957) and Bever (1968) but stress that psychological, pathological, situational, and semantic factors may be equally as or more important than deep structure and transformational relationships in generating sentences.

In general, the above cited studies support Miller's coding hypothesis and Bever's kernalization strategy. Sentence processing is shown to involve reduction to the underlying form. Sentences seem to be represented in memory not as surface structure but as some minimal representation of semantic content and a set of specifications for deriving surface structure. Sentences nearest the kernel form are generally easiest to process, and transformational history appears to be a good measure of sentence complexity. Sentence length and type of words added to the sentence seem to have some effect on the amount of memory space needed to process various sentence types. Differences in recall time, order of items stored in memory, and directions given to subjects also have some effect on the way the material is processed.

The differences in experimental design make direct comparison of results difficult. Different requirements of subjects may have demanded the adoption of different strategies in processing the material. Tasks involving short

sentences or encouraging rote memorization may not have tapped sentence processing strategies. Short sentences may permit easy recall of material without analysis of the linguistic structure.

As Bever (1968) points out, differences in experimental design can affect the way the grammar is reflected in ordering of sentence types. He believes that for different psychological tasks the grammar is related to behavior in different ways (Bever, 1968). The kernalization routine applies to both surface and deep structure, depending on the task. In short-term memory, kernalization applies to the surface structure by reducing the structure to a simple sentence; in long-term memory the strategy applies to deep structure causing errors in which the transformations are forgotten but the deep structure kernel form remains (Bever, 1968).

Comprehension of Transformations

Another series of studies attempted to analyze the comprehension of various transformations, mainly by using modifications of a sentence verification technique. This procedure involves asking subjects to indicate whether a given statement is true or false, to fill in a word to make it true or false, or to determine whether a picture is true or false in reference to a statement.

In 1963, McMahon (reported by Fodor and Garrett, 1966, Garrett and Fodor, 1968, and Ervin-Tripp and Slobin,

1966) used active, negative, and passive sentences and found that negative sentences take longer to verify than either passive or active affirmatives. These results were confirmed by Slobin (1964, reported by Miller and McKean, 1964) with children aged 6 to 12 and by Gough (1965, 1966) using adult subjects.

Studies by Wason (1959, 1961, 1965) and by Wason and Jones (1963) further analyzed the processing of negative information. Wason (1959) showed that the shortest amount of time is needed to process statements which are true affirmatives, a greater amount of time for false affirmatives, a still greater amount of time for true negatives, and that the greatest amount of time is needed for statements which are false negatives. Wason's later studies confirmed these findings in addition to showing that subjects seem to reduce negative sentences to the affirmative and invert the result to the affirmative when decoding negative information (Wason, 1961), that similar results are found when nonsense words are substituted for "is" or "not" in the statements (Wason and Jones, 1963), and that the way the negated property is coded in the description of the stimuli affects the results (Wason, 1965).

The studies on comprehension of transformations using the sentence verification technique support the previous findings on sentence processing and recall. Transformational complexity appears to be an important factor in

comprehension as shown by the facts that affirmative sentences are always verified faster than negatives and that subjects explicitly state that they reduce negative information into the affirmative form during the tasks. Gough (1966) further supported these findings. He controlled sentence length by deleting the agent phrase in P and NP sentences, making them shorter than the active sentences, and found that active sentences are still verified in less time. Thus sentence complexity and not sentence length was shown to be responsible for the results.

Other studies on comprehension, using different experimental techniques, support the coding hypothesis. Morris, Rankine, and Reber (1968), using a sentence reconstruction task, found the order of sentence types, from fastest to slowest response, is active, passive, negative, and negative passive. Coleman (1964) found that active verb transformations are easier to comprehend than comparable passive, nominalization, or adjectivalization transformations. Clark (1966) and Clark and Begun (1968) compared comprehension of active and passive sentences. Differences were found between the two sentence types, indicating that both deep and surface structure are used to judge the sensibleness of the sentences and to alter them, and that the level of the grammatical rules used in processing is dependent on the nature of the task.

These studies on comprehension of transformations, as do those on recall and learning of transformations, support the transformational model. Sentence forms nearer the kernel form are easier to comprehend than those with a more complex transformational history. Although some differences are again found in terms of recall conditions, delay of information has less effect on comprehension than it does on recall or learning syntactic material.

Surface Structure Analysis

The majority of studies on linguistic behavior in adults analyzed this behavior in terms of derivational history and transformational complexity. Several other studies analyzed this behavior by investigating surface structure of sentences in terms of sequential probabilities or in terms of the depth measure of Yngve (1960).

The investigations using surface structure analysis present some useful information about sentence processing. The results of the studies, however, are only partially able to support the theoretical positions, are unable to account adequately for semantic interpretation of sentences, and in some cases are forced to use derivational history to account for the results. These studies place too much emphasis on relationships between key words in the sentence rather than on the underlying syntactic relations needed for complete sentence processing.

Johnson (1965, 1966a, 1966b), Rosenberg (1968), and Coleman (1963, reported by Johnson, 1968) analyzed use and knowledge of grammar in terms of sequential probabilities. This approach is concerned with the way speakers break up sentences into functional subunits during attempts to learn a sentence. These studies demonstrate that subjects seem to use phrase-sized recoding units in learning sentences, that syntax facilitates learning by allowing subjects to decode higher order units into subunits, and that sequential constraints and the chunking of words into subunits most adequately explain the observed behavior. The findings of these investigators imply that sentence processing does not start until the entire sentence is heard. The findings also imply that sentences are processed from left-to-right. Neither of these implications is completely substantiated by the data.

The alternative approach to surface structure analysis uses the Yngve (1960) model to explore short term memory differences for different sentence types.

Martin and Roberts (1966) had subjects learn sentences which varied in both mean depth and transformational complexity. The results show that regardless of sentence type, the likelihood of correct recall is inversely related to mean depth. The types of errors made in recall indicate that subjects recall a sentence of the same type as that presented but with a lesser mean depth. Recall of kernels

is uniformly inferior to recall of non-kernels. No consistent effect could be attributed to sentence type. The authors suggest reinterpretation of previous data, such as those of Mehler (1963), in terms of depth values. Martin and Roberts (1966) found that the depth values assigned to sentences of increasing complexity also had increasingly greater mean depth values. This result makes it difficult to interpret the findings. If greater mean depth accompanies sentences of greater complexity, it is difficult to determine which is the factor affecting recall. It seems that perhaps both these measures are tapping some basic factor in sentence processing, and that while one philosophical approach and experimental design favor one factor, both may actually be involved.

Martin, Roberts, and Collins (1968) used the mean depth measure to compare short term memory for active and passive sentences at two levels of grammatical complexity. They found better recall of passive sentences with a lower mean depth, but active sentences with higher depth values were recalled better than actives with low depth measures. Passive sentences with a low depth value are best recalled and show least variability in retention.

The study by Martin (1968) on recall of active and passive sentences supported the previous findings but concludes that while sentence complexity (mean depth) affects sentence retention, syntactic type and subject-object

relations are significant factors in sentence processing. Herriot (1968b) studied sentence comprehension and found that sentences with greater depth are more difficult to understand. Herriot (1968b) does note difficulties in absolute assignment of Yngve depth measures to his sentences, partially because he used nonsense material.

Studies by Perfetti (1969a, 1969b) and by Rohrman (1968) question the results of the studies using the depth measure. Perfetti (1969a) required subjects to recall active sentences with a high mean depth and passive sentences with a low mean depth. He found that the active sentences with a high mean depth are recalled more readily than the low depth passive form. This implies that recall is dependent on deep structure differences rather than depth differences. This result was confirmed in Perfetti's (1969b) second study in which correct recall was unaffected by mean depth but was affected by lexical density (the proportion of lexical words to grammatical words in the sentence). Perfetti (1969b) concludes that the depth measure does not reflect the psychological processes involved in the way sentences are analyzed. He does feel that the lexical density is important since it gives a rating to the semantic content load of the sentence. Greater surface structure density may place a heavier load on memory and may be an important factor in recall (Perfetti, 1969b).

Rohrman (1968) criticizes the studies of Martin, Roberts, and Collins (1966) and of Martin (1968) because he feels that they tried to equate sentences in terms of surface structure (mean depth) and deep structure (transformational complexity). In a series of experiments, Rohrman (1968) tested the relative power of deep and surface structure. These experiments compared recall of sentences and of subject and object nominalizations which had combinations of high and low mean depth, simple or complex surface structure, and simple or complex deep structure. He found that for sentence recall sentences with high mean depth, complex surface structure, but simple deep structure are more difficult. His comparisons of nominalizations indicate that mean depth measures cannot account for the results and that recall of nominalizations can only be explained in terms of deep structure complexity. Nominalizations with more complex deep structure (additional nodes in the derivational history) are more difficult to recall (Rohrman, 1968).

Rohrman's (1968) experiments provide a precise methodology for determining the relative importance of deep and surface structure in facilitating recall. His experiments clearly show the importance of deep structure in remembering sentences and provide strong support for the supposition that deep structure is the level which is represented in memory. Rohrman concludes:

> It seems reasonable to suppose that the transformations may be in long-term storage as part of the structure of the mind. Upon hearing a sentence, S places the deep structure in short-term storage; and at retrieval, the transformations are applied automatically, triggered by dummy elements in the deep structure. These dummy elements, involving additional nodes, cause the deep structure to be more complicated than if they were not present. Thus, the deep structure of a passive sentence is more complex than one for a corresponding active sentence, for it contains an element for triggering that transformation; and in some cases, there is in essence a correspondence between transformational history and deep structure complexity. (Rohrman, 1968, p. 912)

This review of studies on linguistic behavior in adults has attempted to provide some insight into the possible strategies adult speakers use to process sentences. The results of the studies strongly support deep structure analysis, transformational history, and the coding hypothesis as the most meaningful available approach to both account for the results and to infer processes involved in learning, recalling, and understanding syntactic material. The results show that surface structure analysis will not account for all the results. As indicated earlier, factors of memory, nature and type of syntactic material, semantic content, method of presentation of material, as well as task required of subjects, all need to be investigated in greater depth in order to elucidate more clearly the strategies and processes adults use to understand and create sentences.

Studies of Linguistic Behavior in Children

The development of linguistic skills in children has been studied for many years using many different approaches. Many of the earlier studies were concerned with speech sound development. These studies discussed the acquisition of phonology by tracing the child's development through stages of reflexive vocalizations, babbling, and echolalia. Other studies catalogued words and phrases children use at various ages. The early studies did not attempt to analyze these utterances in terms of the linguistic rules of the child's language community.

The following review will briefly discuss the early naturalistic studies of children and the investigations using mean length of response as a measure of language maturity. These studies are important to the present research as an historical perspective on the kinds of data available for more comprehensive linguistic analysis. The emphasis of this section will be on the child's acquisition of syntactic structures and on the use of elicited imitation as the tool to assess the child's competence. The child's acquisition of linguistic rules, the theories to account for this rule acquisition, and the experimental demonstration of the processes involved in the child's acquisition of syntax will be discussed as well.

Early Studies

Naturalistic Studies

Accounts by Jespersen (1922), Nice (1925), Boyd (1926), M. E. Smith (1933, 1935), and Brigance (1934) present early observations on the development of parts of speech and of certain sentence types. These reports were based on spontaneous utterances of a single child or group of children.

Jespersen (1922) was the first to point out that children seem to learn the rules of the language even though these are never explained to him. He believed that a child must invent new forms from previously learned forms because language learning would be too unwieldy if this did not occur. Jespersen (1922) discusses the development of possessives, plurals, and verb tense, noting the child's tendency to regularize irregular forms. He points out the early appearance of negative and interrogative forms, both of which are important to the child's relationship to his environment. Jespersen (1922) states that the age of acquisition of a particular grammatical class is less interesting than the growth of command of that class and the ways in which mistakes and confusions are corrected.

Nice (1925) and Boyd (1926) describe the development of sentences and suggest mean length of response as a good measure of language development since it shows a steady increase with age. Boyd (1926) counted the sentence types

his daughter used and found that between age three and four his daughter used parts of speech and sentence types in approximately the same proportions as used by adults. Smith (1933, 1935) confirmed these earlier observations. She felt that in addition to mean number of words in a sentence, an error index (mean number of errors per word) was also an important indicator of language development. The errors children make on various grammatical forms were believed to be indicative of the child's attempt to acquire the forms in a systematic fashion (Smith, 1933). Brigance (1934) and LaBrant (1933) presented further observations on the growth of linguistic skills which reiterated the earlier descriptions of child language.

These early naturalistic studies present aspects of linguistic development which may be important in a study of language acquisition. The studies demonstrated the steady increase in usage of language, showed the types of errors children make, and attempted to describe the ways children complexify language. Only the writings of Jespersen (1922) made any attempt at relating the child's usage of language to the adult target language.

These early studies did not attempt to formulate the linguistic rules a child uses at various stages of development. The studies confirm the obvious fact that child language increases in complexity with age. The "how" of this complexification process is left largely unanswered.

Mean Length of Response Studies

Studies by Davis (1937), Young (1941), McCarthy (1954), and Templin (1957) all used mean length of response as a measure of linguistic development. These authors all found MLR increases with age, and that by about age four children seem to have acquired all parts of speech in approximately the same proportion as have adults. McCarthy (1954) states that MLR is probably the most reliable, easily determinable, easily understood, and objective method for determing language maturity, and that part-of-speech analysis can give additional valuable information about language development.

More recently, Shriner (1967) and Shriner and Sherman (1967) performed more sophisticated analysis on MLR measures. Their studies indicate that MLR is the best single predictor of language development but that an additional measure which would balance sentence length and complexity is still needed.

The studies on MLR further document the increase in linguistic skills with age. They do not shed further light on "how" or "what" is learned. They do not clarify the sequence of development or the relationship of the acquisition of various syntactic structures to each other.

Pre-Psycholinguistic Studies

Studies by Kahane, Kahane, and Saporta (1958), Weir (1962), and Leopold (1954) attempted to analyze the items of child speech within a linguistic framework.

Kahane, Kahane, and Saporta (1958) studied children's development of verbal categories. The patterns analyzed included both those in which the categories correspond to adult structure, in that a contrast in meaning is correlated with a contrast in form, and those in which no such contrast is seen. The children were able to comprehend distinctions which they were not yet producing, supporting the familiar statement in the literature that children are able to comprehend grammatical contrasts before they are able to use them spontaneously.

Other accounts of language development in the 1950s (see for example Van Riper, 1950, Lewis, 1957) continued to present an extremely simplistic and superficial analysis of an extremely complex process. The descriptions of Leopold (1954) and Weir (1962) of their own children's developments both attempted to analyze child language in terms of phonological, morphological, and syntactic systems. These authors found morphological rules developed later than syntactic rules and point to the importance of imitation of adult patterns as an initial way for the child to acquire linguistic rules. Leopold (1954) and Weir (1962) believe that the child's imitations must serve as a mechanism for the internalization and elaboration of the linguistic rules of the language community.

Several investigators used different classification units to analyze child language. Loban (1963) analyzed

child utterances into communication units (single, independent predications). Strickland (1962) used phonological units to trace the development of syntax. The T-unit, developed by Hunt (1966), and used by Brett (1965) and by O'Donnell, Griffin, and Norris (1967) combined transformational analysis with analysis based on clause construction. The T-unit was used to analyze linguistic development and appeared to be a valid method of measuring linguistic maturity. These approaches, however, only present alternate methods for surface structure analysis of performance. The procedures make no attempt to assess linguistic competence in the sense of Chomsky.

Carroll (1961) emphasized the need to study not only the items children say but the relationships and distinctions the child makes between them. Carroll (1961) points out that naturalistic studies give only items of what the child says but that experimental studies might begin to uncover what the child means and knows about what he says. Carroll (1961) theorizes that children learn syntax and morphology by first imitating large units (sentences, phrases, verb tense) and then differentiating component parts as the function of these parts is learned.

The study of language development prior to the 1960s presents items of what children learn based mainly on longitudinal, naturalistic studies of single children. These investigations present a voluminous amount of material which

is difficult to analyze, gives only outlines of behavior, and makes comparison of data collected by different investigators almost impossible. Generalizations about the development of one child to children in general cannot be made on the basis of these early observations. The studies referred to are unable to clarify relationships between emerging linguistic systems. The studies do not attempt to show the interaction of the child's understanding of specific linguistic items with his ability to spontaneously produce these items.

Chomsky's linguistic theory, taken into the realm of children by McNeill, Lenneberg, Fodor, and others, provides a theoretical hypothesis and a new approach in the attempt to analyze what the child produces, understands, and knows about his language. This approach encouraged investigators to trace the child's development as it approximates the accepted system of his language community and to analyze child language as an organized system of increasing complexity.

Theoretical Hypotheses to Explain the Acquisition of Syntactic Structures

In a period of about two years children regularly learn the essentials of a very complex adult system of language usage. A number of authors have formulated hypotheses to explain how children acquire this complex linguistic system.

Several of these researchers (see for example, Jenkins and Palermo, 1964) proposed a stimulus-response mediation theory to explain language acquisition. This approach views language acquisition as a process of associating words which occur in the same or equivalent contexts. A modification of S-R theory is the explanation given by Braine (1963b), who explains the learning of grammatical structure by a process of contextual generalization. Structure is learned by learning the position of a word in a sequence and then generalizing this learning to another context. This generalization occurs even if no associations have been previously formed between the word and the new context.

Braine (1963a) analyzed the spontaneous speech of children of about two years of age. He found some similarities in the structures used by these children. The children use two word classes which Braine (1963a) calls "pivot" and "X" words. Pivot words are few in number and contain two sub-classes, those appearing in sentence initial and those in sentence final position. The "X" words are a large open class containing the child's entire vocabulary minus the pivot words. Braine (1963a) explains the first phase of language development as the learning of the position of pivot words in an utterance. The system is expanded structurally by forming new pivots (learning the utterance position of new words) and by adding new vocabulary items to the "X" class.

Braine (1963b) also conducted a series of experiments in which children and adults learned miniature artificial language systems. He feels that these experiments, while not providing data on how natural languages are learned, can provide a methodology for studying learning and generalization processes presumably involved in natural language learning. The results of these experiments showed that what is learned is the position of a word in a combination.

Braine (1963b, 1965b) proposes a theory of language acquisition extrapolated from his results with artificial language learning. He states that in order to account for learning an intricate set of grammatical structures the theory must first account for the learning of kernel sentences. First, he says, what is learned are locations of units and associations between pairs of morphemes. Secondly, the location which is learned is the location of a unit within the next larger containing unit of a hierarchy of units. He postulates two levels of hierarchies (Braine, 1963b). Within sentence units are primary phrases and sequences of primary phrases. Within primary phrases, the units are morphemes. Thirdly, learning the grammar is a process of becoming familiar with the sounds of expression in the temporal position in which they recur (Braine, 1963b). He assumes that subjects learning a language tend to form associations betweem morphemes of the language. The strongest associations are formed between closed-class morphemes,

weaker ones between open and closed class morphemes, and little strength between pairs of open-class morphemes. Braine (1963b) hypothesizes that the learning of positional regularities and associations between morphemes explains the overgeneralization of linguistic rules which children make in learning grammar. These overgeneralizations depend on the relative rates of learning the positional regularities and the associations between morphemes. While Braine (1965a) admits that there are limitations in generalizing about natural language learning from studies on artificial language learning, he concludes that contextual generalization is as good a description of the process as any other, particularly in view of the lack of information about the child's verbal environment and response to it.

Braine's position has been the focus of some criticism. This reviewer feels his formulations are particularly limited in allowing for generalization to stages of linguistic development beyond the learning of kernel sentences. The explanation does not sufficiently allow for enumeration of the wide range of utterances two and three year olds do produce. The theory also makes no provisions for the acquisition of complex sentential material.

Braine's theory of contextual generalization was criticized by Bever, Fodor, and Weksel (1965a, 1965b) who argue that contextual generalization cannot account for what children learn about the structure of language or the

relationship between sentences. They point out that the child's ability to deal with novel sentences is a major part of his linguistic competence which must be explained in any theory of language and that Braine's theory does not do so adequately. Bever, Fodor, and Weksel (1965a) indicate that there is no reason to suppose that the child hears mainly simple declarative sentences and that, although the child's verbal environment is an important factor in his language development, the features which are critical for language learning are not known. Bever, Fodor, and Weksel (1965a) emphasize that children learn to manipulate underlying structures of the language for which there are no explicit models and point to the inadequacy of a theory based on contextual generalization to account for the relationships between sentence types and for the construction of complicated sentence types.

An alternative theory of language acquisition attempts to explain how children internalize the abstract nature of language and learn structures for which no explicit models exist. Lenneberg (1966, 1967) states that the first things children learn are principles, not items. They learn principles of categorization so that first words refer to classes of items or events. Even in the earliest stages, very general principles of semantics and syntax are demonstrated in the child's language.

McNeill (1966a, 1966b, 1968) proposes a theory of language acquisition based on the abstract structures underlying linguistic competence. This, to a great extent, is an extrapolation from Chomsky's (1957, 1965) theoretical formulations. McNeill (1966b) indicates that children's earliest utterances show basic grammatical relationships which could not have been imitated, could not have been explained by "creative abilities," nor could not have been copied from parental speech. Following the work of Chomsky, McNeill (1966b) hypothesizes that the basic grammatical relations, such as are defined in terms of deep structure of a sentence, are part of an innate linguistic capacity. A language acquisition device (LAD) or system (LAS) receives primary linguistic data (a corpus of speech from the fluent speakers of the language) as input and has grammatical competence as output. The contents of LAD are linguistic universals, which theoretically allows this formulation to explain acquisition of any natural language. As LAD receives these data, it formulates hypotheses about linguistic regularities. The hypotheses are changed and modified as new data are received. These preliminary data give LAD a basis for selecting among and organizing various universal distinctions appropriate to the specific language. Simultaneously, LAD searches for sentence patterns which correspond to the basic grammatical relations of the language. LAD apparently recognizes these within limits set by the

grammatical categories it has differentiated and, from these preliminary data, must recover the particular orders of constituents which are used in the specific language community. Experience provides data for selecting the appropriate rules of the language.

Children's early utterances indicate limited competence. They have a few grammatical classes which are used in simple hierarchical rules reflecting basic grammatical relationships which are part of the base structure of sentences. Transformational operations do not develop until later. McNeill (1966b) states that if children's early competence is limited to base structures it is difficult to see how this can be extended by any theory of language acquisition which is restricted to what a child is able to observe from the surface structure of adult speech.

Fodor (1966) also emphasizes that the fundamental problem in syntactical learning is inducing the underlying structures of a particular language. He feels that learning theory and imitation of adult models cannot explain how children learn the correct base structures for any sentence type, since these are abstract relationships which are never uttered directly and which therefore cannot be imitated or reinforced (Fodor, 1966). Menyuk and Tikofsky (1968) concur with this view and state that the way the child produces and understands utterances depends on his level of competence. Wick Miller (1964) also states that

before the child learns to use language he must learn the formal features of both the phonological and grammatical systems of his language. In order to produce new sentences grammatical rules must be learned. Even the earliest sentence patterns indicate approximations to adult rules. Words are not placed in random order and even ungrammatical utterances represent approaches to the target pattern (W. Miller, 1964).

There are a number of advantages to a theoretical approach as presented above in explaining language acquisition. First, it allows for the explanation of the acquisition of any natural language, since the specific corpus input determines the grammatical system which subsequently develops. Hypothesizing a LAD permits comparisons of children whose language backgrounds are different. Secondly, LAD eliminates the difficulty of explaining the child's utterances of both novel and ungrammatical (in terms of adult usage) sentences for which there is obviously no model. A system of rules and a hierarchy of categories allows for step-by-step progress toward adult form and for analysis of child language in terms of a sequence of alternate candidate grammars, each stage built on insufficient preliminary data at that time. Thus child language at various stages can be analyzed in terms of the current state of LAD's competence. The errors and changes made in the rules reflect the child's attempts to make his linguistic data fit the language system of his experience.

Evidence for the Acquisition of Linguistic Rules

Recent studies have analyzed results in terms of the hypothesis that children systematically acquire the rules of their language. These studies have shown that children do have rules for generating sentences. The results also indicate that different children develop in remarkably similar ways in terms of stages of development and acquisition of basic operations for sentence generation.

Studies by Berko (1958) and Brown and Berko (1960) show that children have a knowledge of the English inflectional system which allows them to go beyond their corpus to construct new forms. Cazden (1968), Menyuk (1968), and Messer (1967) conclude that on phonological and morphological levels children learn grammatical sequences according to a system of rules which are developed and expanded with age.

The development of sentences begins around the age of 18 to 24 months when children begin to form two and three word sentences (Brown and Fraser, 1963, McNeill, 1966b). Early sentences tend to be "telegraphic." These are reduced versions of adult sentences containing mainly content words and a few operators performing special functions (Brown and Fraser, 1963). Children tend to omit function words and retain content words and stressed parts of adult sentences. This may be partially due to the child's short auditory memory but may also be related to paucity of grammatical

rules, since the memory factor cannot account for the child's ungrammatical combinations. The records of the speech of two year olds indicate that early word combinations are not random (Brown and Fraser, 1963). A large number of these utterances conform to a small number of simple patterns, indicating the use of rules by children even at this early age.

McNeill (1966b) notes that in the early stages the child is discovering the basic phrase structure rules of sentence formulation. These early two-word sentences tend to be combinations of two word classes, "pivot" and "open" words. The pivots resemble function words and are fewer in number than the open words. The child uses rules for combining pivot and open words to create unique utterances. The child learns early the essential subject-predicate nature of adult sentences and he experiments with noun-phrase, verb-phrase, and other grammatical forms (McNeill, 1966b). The early rules are sequential and lack hierarchy. Later rules are hierarchical and will generate sentences which are not well formed, according to adult standards, but which do form the components of the basic adult pattern: S $\longrightarrow$ NP + Pred. P. Thus the child can generate the major constituents of adult sentences as separate items. When he is able simultaneously to apply both halves of the rule he will be able to generate a single adult sentence (McNeill, 1966b).

Brown and Fraser (1963) obtained a corpus from each of 13 children aged 24 to 36 months and analyzed the utterances in terms of syntactic categories of adult grammar. The utterances were classified according to the sentence type each most closely approximated. Brown and Fraser (1963) found that when they ordered the utterances in terms of mean length of response, rather than age level, all the children did similar things in reducing English sentences. In general, it was found that children whose speech is not yet English use grammars which are systematic derivatives of adult grammar and that particular features are predictable from the child's mean length of response (Brown and Fraser, 1963). These authors conclude that "child speech is a systematic reduction of adult speech largely accomplished by omitting function words which carry little information" (Brown and Fraser, 1963, p. 195). At some point, children must do more than imitate and memorize adult sentences. They must "induce general rules which govern the construction of new utterances" (Brown and Fraser, 1963, p. 196).

Brown and Bellugi (1964) came to similar conclusions in a longitudinal study of two children. This began when Adam was 27 months old and Eve was 18 months of age. Analysis of the children's utterances led to the postulation of three processes which appeared to be operating in the children's syntactic learning. These are imitation and

reduction, imitation with expansion, and induction of latent structure. The earliest spontaneous imitations of Adam and Eve preserve word order of the model sentence, indicating that the adult sentences have been processed as total constructions rather than as lists of words. The fact that these early imitations continue to be reductions even when the model sentence increases in length indicates that the child is limited by some constraint of immediate memory or programming span. This is also shown by the observation that the spontaneous utterances are about the same length as the imitated ones. Adult expansion of the child's utterances supply additional information for the child to use to induce the rules of his language, but the expansions cannot account for the degree of competence the children acquire (Brown and Bellugi, 1964).

Miller and Ervin (1964) analyzed the utterances of 25 children and found a primitive grammatical system consisting of sentences of two or more words by the age of two years. This early system is not the same as an adult model but often can be translated into such a system by adding function words and inflectional affixes. Some general characteristics of this early system are presented by Miller and Ervin (1964). The children use a few high frequency words which tend to be restricted to a given position in the sentences and which define the meaning of the sentence. The children also often take a construction which may be a

complete predication for them and treat it as an expansion of one part of another construction. Miller and Ervin (1964) found a complex grammatical system in these two year old children. The system was constantly changing, making it difficult to analyze and to classify all the utterances systematically. This difficulty was reduced as the children became older and their grammatical system became more sophisticated.

Transformations did not occur in the earliest linguistic systems of these children. The first transformations to appear were simple, non-generalized transformations such as progressive, inversion of word order for questions, and use of auxiliary with "not." Around the age of 2.5 years, coordinative transformations with "and" appeared (Miller and Ervin, 1964).

Miller and Ervin (1964) point out that all the children did not follow the identical sequence nor can rules be written for all utterances of all the children. While these differences may be due to differences in language style or stage of development, part of the difficulty may be related to attempting to force the child's response into an hypothesized reduced approximation of the adult target language. Some of the utterances which prove difficult to classify may be instances of attempts by the child which are so far removed from the adult model that they are unanalyzable in terms of approach to the model.

Another study which relied on spontaneous imitation of adult sentences as well as collection of spontaneous utterances is that of Ervin (1964). She was interested in the relationship of the structure of the imitated responses to the structure of the spontaneous utterances in order to determine whether or not the former are grammatically different from the latter, and if they are different, whether or not the imitated utterances are more advanced. Grammatical rules were written for freely generated utterances of five two year olds and the rules were used to compare the children's overt, immediate repetitions. For four of the children, both the imitated and freely generated sentences were equally predictable from the grammar. The fifth child demonstrated a very different grammar. Her imitations did not fit the system because the system of rules was incongruent with the child's linguistic system at that stage. Ervin (1964) concludes that imitations, under conditions of spontaneous, immediate recall, are not grammatically progressive; that is, they are neither more nor less advanced than other types of utterances. This implies that spontaneous imitation cannot be the process children rely on in learning language. While Ervin's subjects did imitate a great deal, they also produced many sentences which followed rules in some cases similar but in others quite different from adult models (Ervin, 1964).

The investigations of Menyuk (1963a, 1964a, 1964b, 1967, 1969) describe the development of syntactic structures in children aged three to seven and present further evidence that children acquire linguistic rules. Menyuk compiled data in which utterances were divided according to grammatical rules at phrase-structure, transformational, and morphological levels.

Menyuk's studies indicate that by the age of three years most children use sentences which contain all the basic syntactic structures used by adults. At the same time, sentences are produced which deviate from correct usage. The underlying structure of the grammar of these children includes usage of grammatical relations (subject-object), syntactic order (subject-verb-object), and syntactic classes (noun, verb, determiner, adverb, etc.) (Menyuk, 1969).

Menyuk (1969) analyzed base structures in sentences of two children, aged two years to 2.9 years. At this early stage, the children use subject-predicate relationships more frequently that simple predicate. Noun phrases consist of determiner plus noun. Prepositional phrases indicating place are used between the ages of 2.4 years and 2.7 years while manner and time prepositional phrases do not occur until later. Use of verb phrases at this stage involves both development of morphological markers for tense and number and the acquisition of auxiliary and modal verbs. Children in this age group show increased use of elaborated forms of

basic rules with expansion of nodes in the base structure string and incorporation of several sentences into one. Rules are used both correctly and incorrectly at this stage. Word order seems to be subject plus verb with object position optional. Deviations in rule usage include non-expansion or omission of a symbol in the string, conflict with selectional restrictions in violation of or substitution for a strict subcategorization rule, and redundancy or further expansion of a terminal symbol (Menyuk, 1969).

The earliest use of transformations is stress and intonation rules to signify a statement, a question, and an emphatic (Menyuk, 1969). Limited use of a question morpheme without a copular verb is found, as is use of negative and question in imperative sentences. Menyuk's data indicate that what appear to be the rudiments of transformations in these early stages is probably use of these structures as separate vocabulary items. As the child learns to use auxiliaries and modals, well-formed question, negative, and declarative sentences occur more frequently (Menyuk, 1969). Menyuk (1964c) points out that the increased sentence complexity over the age range is not simply dependent upon increased sentence length or increased use of compound or complex sentences. The complexity is dependent upon the addition of rules to the grammar and upon the orderly application of increasingly more differentiated rules.

Menyuk (1964b) also compared the grammatical systems of children diagnosed as using infantile speech (IS) with normal speaking children (NS) aged three years to 5.10 years. These results showed that more NS children use more transformational types at an earlier age and with greater consistency. A qualitative difference was also found between the two groups in terms of rule usage. The grammatical system of the oldest IS child did not match that of the youngest NS child. The IS child seems to be using the most generalized rules or first approximations to rules in sentence generation. The NS child rapidly acquires increasingly differentiated rules as he matures, whereas, the IS child seems to be unable to progress beyond elementary and generalized rules. Menyuk (1964b) concludes that the label "infantile speech" is a misnomer, since a qualitative difference is found between these two groups of children. While this is certainly true, Menyuk presents no definition of infantile speech nor any specification of the criteria used for diagnosing this problem.

Bloom (1970) criticizes Menyuk's analysis of child language. Bloom (1970) feels that Menyuk has merely classified sentence types without relating the rules needed to generate each type to similar and different sentence types. She also feels that Menyuk has not presented evidence that her subjects productively generated the rules of the grammar (Bloom, 1970).

Although some of Bloom's criticism may be valid, Menyuk has attempted to relate competence and performance in terms of the sequential emergence of different linguistic systems and the deviations children make as they approach correct usage.

Lee (1966) found results similar to those of Menyuk (1964b) in comparing a normal speaking child and one with "language delay." She analyzed the responses of the two children in terms of her own theoretical construct which she calls Developmental Sentence Types (Lee, 1966). Lee indicates that this type of classification system, based on assigning utterances to a specific sentence type, makes it easier to analyze children's productions and to uncover areas of abnormal syntax in atypical children. In comparing the productions of these two children, Lee (1966) finds that the child with delayed speech does not seem to be following the natural patterns at a slower rate, but that he is failing to make linguistic generalizations upon which syntactic development depends.

It seems premature to accept the usefulness of Lee's method of analysis based on only two cases. Her sentence types may be useful in analyzing the speech of very young children but seem insufficient to handle the complexity found in the language of the older child. The Developmental Sentence Types do not appear to be any more useful or much simpler than an analysis based on generative grammar as used

by Menyuk. Bloom (1967) points out that Lee's analysis only accounts for surface structure. This may lead to conclusions about the child's performance without the benefit of analyzing the development of those deep structures which are important to or lead to the observed utterance. Analysis of surface structure allows for only limited hypotheses to be formulated about the child's competence.

Brannon (1968) compared three and four year old children's use of 26 transformations in a study which follows Menyuk's type of syntactic analysis. He found a significant difference in transformational usage by the two age groups. The results indicate that the older children use more complex sentences involving both simple and generalized transformations. He suggests that linguistic development follows acquisition of phrase structure rules, then simple (singular) transformations, and finally generalized (double-base) transformations (Brannon, 1968).

Lackner (1968) attempted to write a transformational grammar for retarded children at different stages of development on the assumption that the retarded child's language would yield a slow motion picture of normal language development. He was able to write phrase structure and transformation rules of the retarded children (Lackner, 1968). The phrase structure rules appear to be compatible with adult usage although of a less complex nature. Lackner (1968) concludes that language behavior of normal and retarded

children is not qualitatively different, that both groups follow similar developmental trends, but that the retarded child becomes arrested in development and remains at a lower level of linguistic development.

The above investigations have shown, through analysis of spontaneous speech and description of similarities in development in different children, that children's utterances conform to a grammatical system and that acquisition of language involves learning linguistic rules. These studies, however, only present data on performance. The large number of utterances these investigators have amassed are difficult to analyze. The utterances represent only a limited sample of the possible sequences a child is able to produce. It is also difficult to compare the results of the studies because of differences in the actual responses of the children, the methods used to elicit the utterances, and the methods used to write tenative grammars for children in different stages of development. The investigator must also make many inferences about what he thinks a child's utterance means, and his analysis of the child's system may be influenced by his own knowledge of the grammatical rules of the language.

None of the investigations define "normal." They assume that a child of educated parents or one who is in a normal school program will develop language normally. There is no attempt to assess other aspects of development or use

any standard criteria for making the assumption that a child is developing language normally.

Despite these limitations, the present writer believes that the studies present undeniable evidence that language development involves internalization and elaboration of linguistic rules at all levels of linguistic analysis. Further support for this conclusion will be presented in the studies which attempt to assess linguistic competence.

Development of Specific Transformations

Ervin (1964), Bellugi (1965, 1968), Klima and Bellugi (1966), and Brown (1968), through careful analysis of children's spontaneous utterances, spontaneous imitations, privileges of occurrence of grammatical forms, and through some assessment of comprehension, trace the emergence of specific transformations.

Ervin (1964) discusses the development of the "do" transformation in two to four year old children as shown by spontaneous imitations. The utterances of these children indicate that although adults may use a basic set of rules for use of "do" children do not do this. The children use "don't" early in negatives and often as the only negative signal. In interrogatives, children ask a question by using a question word or rising intonation but do not use "do" in questions until they learn to use "do" in negatives or ellipsis. Ervin (1964) concludes that the process of acquisition of language cannot be inferred from analysis of adult

structure. Sentences which are described as generated by transformational rules in adult grammar may be based on simpler rules in early child grammar. A rule which may apply to a variety of adult sentence types may develop through separate and independent lines in children. Ervin states:

> Any system of analysis which omits either the idiosyncratically structured and rule-governed features of children's language or the gradual changes within these rules is contradicted by evidence from all levels of linguistic behavior in children. (Ervin, 1964, p. 188)

Bellugi (1965) and Klima and Bellugi (1966) discuss the development of negative and interrogative structures in child speech. Their analysis is based on a developmental study of three children with an attempt to categorize regularities found in the development of negative and question transformations, and to note the stages children go through as they approach adult usage. Three stages were outlined which were based on several thousand utterances of these children.

The sentences children use in Stage 1 average two morphemes (Bellugi, 1965). Inflections, auxiliaries, articles, determiners, quantifiers, and most pronouns are absent but the children are able to express basic sentence functions of declarative, negative, imperative, and question. "No" and "not" are used to signal negation and may either precede or follow the rest of the utterance. The children at this stage do not clearly distinguish between wh- and

yes-no questions and signal yes-no questions only by rising intonation with additional use of a few routine wh-questions.

In the development of the negative transformation in Stage 2, there appears to be a residue of elements of Stage 1 coexisting with a new set of rules (Klima and Bellugi, 1966). The basic structure of Stage 2 is:

$$S \longrightarrow \text{Nominal} - (\text{Aux}^{neg}) - \begin{Bmatrix}\text{Predicate}\\ \text{Main Verb}\end{Bmatrix}$$

(where the negative has possible lexical representation as "can't," "don't," "not," and occasionally "no"). The auxiliary verb occurs with negatives but not in questions or declaratives. Other uses of the negative at this stage include use of a negative element within a sentence but not connected to the main verb, several occurrences of a negative followed by a predicate, and use of both affirmative and negative imperatives. From parent-child conversations, it is shown that the children do understand a negative embedded in an auxiliary (Klima and Bellugi, 1966). There is also some evidence that children use negatives to negate a preposition.

The interrogative development in Stage 2 shows a continuation of the form of questioning used in Stage 1. There is an increase in usage of many parts of speech and the interrogative word "what" appears in sentences with missing objects. In wh-questions, all the wh-words are in initial position and all auxiliaries are omitted in questions. Yes-no questions are still formed by rising

intonation only. A transformational rule emerges to order appropriately the questions. Klima and Bellugi (1966) also find that by Stage 2 children can appropriately answer most questions. The answers to questions reflect understanding that the object of a verb or preposition is being questioned.

The development of negatives in Stage 3 is influenced by the appearance of modal auxiliaries in negatives and questions as well as in declaratives indicating that auxiliaries are not separated from the negative elements. Indeterminants start to appear in affirmative as well as negative sentences. The transformations of optional "be" deletion and "do" deletion appear in Stage 3.

A great many changes occur in use of interrogatives by Stage 3 (Klima and Bellugi, 1966). There is appearance of a class of verbal forms which invert subjects in yes-no questions and which can take negative particles. "Do" occurs only as a helping verb in inverted questions and negatives but seldom in wh-questions. The system is similar to that of adults, but auxiliaries are not inverted with the subject noun phrase in wh-questions and the auxiliary system is still not fully developed. There is additional use of inflections and the first occurrence of relative clauses and other types of embedding. In yes-no questions, auxiliaries are correctly inverted; but although the auxiliaries are also present in affirmative sentences, they are generally not used appropriately in wh-questions.

Bellugi (1965) and Klima and Bellugi (1966) note that the three children studied went through these stages in a similar manner. Differences which existed appear to be alternate pathways to the same end and are only superficial.

Huxley (1966) discusses the presentation of Klima and Bellugi (1966) and points out that this analysis does not really deal with children's competence, that this type of analysis is time consuming, and might be an incorrect representation of competence. She does feel that this type of analysis is an important first step in a more complete and accurate study of competence.

The orderly progression to grammatical development as represented by syntactic regularities in children's language systems is discussed further by Bellugi (1968). In addition to her data on development of interrogatives, she discusses the development of case marking. Case marking refers to objective case pronouns in conjoined noun phrases such as "can me and him play with this?" (Bellugi, 1968). This construction is not heard by the children and is deviant in English. Two of the children used it late in linguistic development. By analyzing the use of this form in spontaneous speech, the development of case marking was presented as a set of changing hypotheses about the linguistic structure the child hears. Bellugi concludes with the preliminary hypothesis that "the child's language

system develops as a function of increasing conditions on the applicability of rules" (Bellugi, 1968, p. 48).

Brown (1968) analyzed the speech samples of three children (the same as those of Bellugi, 1965, and Klima and Bellugi, 1966) for the development of wh-questions and the relationship of children's questions to adult rules. The children's speech was categorized according to number of morphemes produced at specific levels. All the children's answers to parental wh-questions and for one child (Adam) all answers to "why" questions were analyzed (Brown, 1968).

Brown (1968) found that prior to Level III (2.75 morphemes) there is no evidence that the children's questions are rule governed. There is use of a few wh-questions, but no evidence that adult transformational processes are operating. Around Level III, some rule usage begins. All three children produce declarative sentences with noun phrase subject, main verb and noun phrase object and locative adverbials and correctly answer questions requiring these constituents 50 per cent of the time. Brown (1968) expected the children to develop the occasional form of questions next (where a wh-word is in sentence final position and spoken with rising intonation and heavy stress). This did not occur and the occasional form never became frequent in the children's usage. All three children did produce an ungrammatical form. This construction approximated both the occasional and normal form of adult questions and was

characterized by preposing (moving the wh-word to the beginning of the sentence) without transposing (interchanging subject of sentence with auxiliary verb) (Brown, 1968).

Brown (1968) also presents some evidence that children have the constituents of wh-questions, in that they are able to answer various wh-questions correctly. The children answer a given type of question in the appropriate form before they spontaneously construct that type of question. In the early period, none of the children answered "why" questions in a semantically sensible way. Many of Adam's "why" questions were closely related to an immediate antecedent declarative spoken by his mother. His attempts at "why" and "why not" transformations may have been inadequate attempts to imitate according to his present level of understanding. Brown (1968) concludes that preschool children develop an underlying grammatical structure for wh-questions which is similar to current transformational grammar descriptions. The children must have some way of organizing different items and sequences which are superficially dissimilar but which have the same meaning.

The goal of much of the research on child language thus far presented has been to assess the child's linguistic competence by detailed description of the child's performance as shown in the spontaneous production of language. Brown, Fraser, and Bellugi (1964) in trying to write a

grammar for a single child, attempted to elicit a judgement from the child as to the grammaticality of a sentence. They presented the child with two sentences, one of which was not acceptable according to adult rules of grammar. The child was not able to tell which sentence was "silly." This direct approach to assessing competence proved to be unsatisfactory (Brown, Fraser, and Bellugi, 1964).

Chomsky (1964) discusses some of the problems involved in determing children's linguistic competence. He points out that it is difficult to write a grammar for children since their language is constantly changing. The attempt raises all the unsolved problems of constructing an adult grammar, multiplied by some large factor (Chomsky, 1964). Chomsky (1964) believes that underlying these descriptions of children's speech is an oversimplified concept of the nature of grammatical descriptions. (The studies available at that time relied heavily on performance as the only way to infer competence.) Chomsky (1964) indicates that the deeper question concerns the kinds of structures the individual has succeeded in mastering and internalizing, whether or not he uses them productively. Competence can only be studied through performance, Chomsky says, but it must be approached in "devious and clever ways if any serious result is to be obtained." He goes on to say that it is absurd to attempt to construct a grammar which describes observed linguistic behavior directly.

> If anything far-reaching and real is to be discovered about the actual grammar of the child, than rather devious kinds of observations of his performance, his abilities and his comprehension in many different kinds of circumstances will have to be obtained so that a variety of evidence may be brought to bear on the attempt to determine what is in fact his underlying linguistic competence at each stage of development. (Chomsky, 1964, p. 36)

Direct description of actual verbal output will never give these data (Chomsky, 1964). He calls for further studies which will tap the child's underlying abilities to use and comprehend sentence, to detect deviance and compensate for it, and to apply rules to new situations. Chomsky (1964) suggests that data on comprehension and imitation may be approaches to analyzing the child's underlying linguistic systems.

Lees (1964) also points out problems in analyzing a corpus of child responses for which a grammar is to be written. Not only are there great variations in utterances, but it is erroneous to assume that every utterance is constructed according to bona fide rules (Lees, 1964).

Experimental Studies

Comprehension and Production of Sentences: Active-Passive Contrasts

Several investigators attempted to assess children's linguistic competence by studying their comprehension and/or production of specific grammatical forms. A number of these studies were concerned with similarities and differences in comprehending and producing active and passive sentences

since this contrast preserves meaning while changing structure.

Slobin (1966) measured comprehension in children and adults in terms of reaction time and number of errors involved in deciding whether an active or passive sentence is true or false in relation to a pictured situation. The results show that incorrect responses have longer reaction times than correct ones. Grammatical sentence type was found to be a significant factor throughout the age range. The order of comprehension of sentence types, from easiest to hardest, was K < P < N < PN. This result supports the hypothesis that syntactic complexity is reflected in decoding time.

Hayhurst (1967) investigated the interrelation between grammatical and semantic factors as shown by five to nine year olds ability to produce true passive and negative passive sentences. The children were required to construct a sentence of the same form as a given model. Hayhurst's (1967) results indicate that sentences without expressed actor are easiest to produce, but this is significant only for the younger subjects. Affirmative passives are not used more frequently than negative passives, and errors tend to produce sentences of an easier grammatical form than the desired sentence. A common error at all ages is to produce the kernel form of the required sentence. Hayhurst (1967) interprets her results as indicating that a two-stage

process is not operating in production of passive sentences (translation into kernel form and adding a footnote for the passive). The errors younger subjects make suggest inadequate comprehension of the passive, while the older subjects seem to fail in reconstructing the sentences. Kernalization may be important in comprehension but appears to be less so in sentence reconstruction. The presence of the negative seems to complicate comprehension for the younger subjects and reconstruction for the older ones in that more errors are made in the negative passive sentences (Hayhurst, 1967).

Herriot (1968a) studied children's comprehension of active and passive affirmative sentences. The amount of semantic content was varied by inserting nonsense words in the sentence. Children aged five to nine were asked to select a picture appropriate to a sentence spoken by the examiner. Significant differences were found in sentences using real and nonsense words, although older children were successful with both tasks. Active and passive sentences were not found different in difficulty. Greater difficulties were found when the verb was nonsense than when the subject or object was nonsense. Herriot (1968a) concludes that syntax has semantic reference and that difficulty in sentence comprehension appears to be localized in the verb.

Huttenlocher, Eisenberg, and Strauss (1968) had fourth grade children place toy trucks, one of which was not

movable, in relation to each other according to directions of the examiner. The results indicate that for active statements comprehension is facilitated when the movable truck is the grammatical subject rather than object. For passive sentences, the task is completed faster when the movable truck is described as logical subject, even though it is grammatical object. The passive form takes longer to comprehend and act upon than the active form, confirming prior results. The authors conclude that comprehension is easiest when there is correspondence between the perceived actor in a situation and the logical subject of the statement (Huttenlocher, Eisenberg, and Strauss, 1968).

Turner and Rommetveit (1967b, 1968) also performed experiments on children's comprehension and production of active and passive sentences. They found that by focusing the child's attention on a particular element in the sentence (recipient of action) or by controlling the direction of visual scanning of a picture they were able to increase the number of passive sentences nursery school through third grade children produce (Turner and Rommetveit, 1967b). They also believe that putting sentences into passive form demonstrates some interaction between syntax and semantics and that comprehension of the structure is necessary for correct production relative to the pictured event (Turner and Rommetveit, 1967b).

The 1968 study of Turner and Rommetveit manipulated the voice in which a sentence is recalled by varying the focus of attention both when sentences are being learned and recalled. The results indicate that the focus of attention at storage and retrieval affects the voice in which the sentence is recalled. Correct recall is facilitated when the retrieval picture relates to the subject of the original stimulus or when it depicts the total situation. Sentences are transformed into the opposite voice on recall when sentence subjects are incongruent in picture and sentence. Higher scores are obtained when both actor and acted-upon elements are presented as memory aids, one for storage and one for recall. The errors made, particularly at the kindergarten level, suggest that the area of greatest difficulty between active and passive is the verb form (Turner and Rommetveit, 1968).

Slobin (1968b), in attempting to collect further data to support the coding hypothesis, had children aged five to twelve and adults retell stories. The stories were presented in either full passive sentences or in truncated passive form. The results indicate a general tendency to retell stories in the active voice. However, this occurs more often when retelling the stories presented in the full passive. Truncated passives are recalled verbatim more frequently than full passive in almost every subject of every age. Slobin (1968b) suggests that the truncated

passive may be stored in a different manner than full passive, thus facilitating exact retrieval of the original syntactic form. Slobin (1968b) states that, at least for truncated passives, the coding hypothesis may need revision. The syntactic form of truncated passives does not influence sentence meaning and the syntactic form is retained (Slobin, 1968b). Thus semantic parts of a sentence which are coded in memory may not always correspond to the underlying active affirmative declarative sentence. Again, there appears to be the need for experimental and theoretical data to provide information about the interaction of semantics and syntax in both comprehension and recall. Slobin (1968b) found, as had Turner and Rommetveit (1968), that the verb forms presented the greatest difficulty in young children's attempts to produce passive sentences.

The results of the studies concerned with active-passive contrasts indicate that active sentences are easier to understand and produce. The studies emphasize the importance of semantic and extralinguistic cues in determining ease of comprehension and/or production. There is also some support for the operation of a kernalization strategy in children in their reduction of sentences to a form nearer the kernel structure. However, in children, it appears to be more difficult to separate sentence processing strategies from difficulties in sentence comprehension, production, or reconstruction.

Comprehension and Production of Sentences: Other Grammatical Forms

Gaer (1969) tested children (age three to six) and adults in their ability to comprehend and produce sentences which varied in syntactic type and complexity. The sentence types were active, P, N, and Q, with complexity varied in four levels of embedding. Pictures were used to illustrate the sentences. For the comprehension task, the children were required to respond "yes" or "no" to indicate agreement between a spoken sentence and a picture. The production task involved two parts. Five random numbers were read immediately after each sentence. The child repeated each of the numbers. After the fifth number, he was shown the pictures from the comprehension section and asked to recall the sentence. A similar procedure using written responses was given to the adults.

Results of the study indicate that, except for the three year olds, active sentences are understood significantly better than at least one other type (Gaer, 1969). At five years of age, questions are understood as well as active constructions and no differences exist between passive and question sentences. At age four, passives are not understood as well as questions. Negative sentences have lowest comprehension scores in all subjects but are produced better than questions by three, four, and five year olds. Other production results are the same as comprehension results. Fewer changes in both tasks are found over the

age range on the complexity measures. All children have more difficulty understanding center and double embeddings than simple sentences (Gaer, 1969).

Gaer (1969) points out that there may have been misinterpretations of negative sentences on the comprehension task because of confusions as to whether "yes" or "no" is the correct answer. The passive, which is the last learned in comprehension and provides most difficulty in production interacts with the levels of complexity. The more embeddings there are in a sentence the more operations one needs to change deep into surface structure and the more information one must store for correct production. The combination of the number of operations and amount of information in the sentence makes passive constructions that much more difficult to handle. Gaer (1969) also suggests that memory limitations might have interfered with production and comprehension of the more complex sentences.

Another approach for studying both comprehension and production of sentences is that of Suci, Ammon, and Gamlin (1967) and Ammon (1968). Using the probe-latency technique, these authors show that grammatical structure is an important factor in sentence perception in children. This method involves auditory presentation of a sentence followed by repetition of one of the words in the sentence to which the subject responds as quickly as possible with the next word which had followed in the original sentence. Response

latency is measured and assumed to be a direct function of the relationship between the two words (Suci, Ammon, and Gamlin, 1967). The results of the studies by Suci, Ammon, and Gamlin (1967) and Ammon (1968) show that the technique is valid for examining how a listener structures language and is sensitive to structural variations within sentences. Ammon (1968) found that the number of nodes in the tree diagram from the probe word to the response word is successful in predicting latencies within a sentence type. Ammon (1968) interprets his results as being compatible with the notion that the output of surface structure analysis is the input to deep structure in sentence comprehension.

This probe-latency technique seems to have the potential to analyze linguistic data of various types. Both of the studies using the technique suggest further investigation where sentence length and sentence complexity are controlled so that sentence processing strategies can be more directly revealed.

Studies of Comprehension of various Grammatical Contrasts

Investigations by Carrow (1968), Shipley, Smith, and Gleitman (1969), and Carol Chomsky (1969) analyze the development of comprehension of several grammatical categories in children.

Carrow (1968) traced the development of grammatical and lexical contrasts in two to seven year old children.

Pointing responses to pictures were used to test comprehension of noun, verb, adjective, adverb, and preposition, of category contrasts of case, number, gender, tense, status, voice, and mood, and of syntactical structures of predication, complementation, modification, and coordination. Carrow (1968) found that comprehension varies within each category and that there is not a relationship among the categories in that one does not appear to be learned before another. Some of the contrasts are more difficult to understand than others. The greatest development in comprehension is found between the ages of two and 4.9.

This study is limited in its contribution to understanding development of syntax as measured by comprehension of grammatical contrasts. The emphasis of the items is morphological rather than syntactic. There are few examples of the same kind of item. Thus, there is no way to trace the development of a particular grammatical form. Some items present two choices and others three, which may increase the probability of guessing. The study does show that many grammatical contrasts can be represented pictorially. However, some contrasts are easier to represent than others. This also affects the possibility of correct guessing responses in that there is no control of whether the child responds to the grammatical contrast or to a key word in the sentence.

Shipley, Smith, and Gleitman (1969) studied comprehension in children 15 to 30 months old by noting reactions to semantically or syntactically anomalous commands. Sentences using real words were of four types: well-formed, telegraphic, lengthened telegraphic, and isolated noun command. The four types of commands using nonsense material were: well-formed with a nonsense function word, a nonsense verb, nonsense function words and verb, and telegraphic with nonsense verb. The results show that children whose spontaneous speech is telegraphic obey well-formed commands more often, indicating that competence is better than performance. Children whose speech is holophrastic obey child-form commands more frequently. Both groups respond less often and require more repetitions of commands involving nonsense material (Shipley, Smith, and Gleitman, 1969).

This novel approach demonstrates that comprehension can be assessed without relying on pointing responses to pictured grammatical contrasts. It also shows that children are able to make grammatical distinctions which they are unable to produce.

Carol Chomsky (1969) presents another approach for assessing the development of comprehension. She challenges the generalization in the literature that the child has acquired the syntax of his language by age five. Her study investigated comprehension of four grammatical structures

present in adult language to determine if these are comprehended in children aged five to ten years. The four structures on which the children were interviewed are shown in the following examples: (1) John is easy to see; (2) John promised Bill to go; (3) John asked Bill what to do; and (4) He knew that John was going to win the race. Item (1) above tests the subject of a sentence and the subject of see; (2) tests subject of go; (3) tests subject of do; and (4) tests reference of he (Chomsky, 1969). By manipulation of or reference to objects and by responses to questions, the children's comprehension of these structures was assessed.

The results show that for the structure "easy to see" the younger children answer incorrectly with the number of wrong answers decreasing with age--until nine years when all answers are correct. For the structure relating to "promise," four response categories which seem to be indicative of stages of development are outlined. (It should be noted that the children were tested in knowledge of the meaning of the word "promise" and its use as contrasted with the use of "tell.") The acquisition of the "promise" structure was not as age dependent as the first; in some of the children it was acquired by age five, by others not until age nine (Chomsky, 1969). For the construction involving "ask," which was contrasted with the use of "tell," the five and six year olds interpret "ask"

as if "tell" had been said. Further testing indicated that the children at this stage impose a "tell" interpretation on both words. Even with extensive testing, results were equivocal as to whether even the oldest children have completely mastered use of this construction. Three structures were examined in children's comprehension of pronominalization. Results on this testing indicate the highest correlation with age. The principles of pronominalization appear to be acquired by a majority of the children at about the same age (5.6 years) without the variety in age of acquisition found with the other structures. Carol Chomsky (1969) explains this on the basis of a qualitative difference in the rules needed for the constructions. Pronominalization rules are based on a general principle applying to a whole sentence, rather than on lexical exceptions. She hypothesizes that perhaps pronominalization is a more basic tool of language, while the other constructions are specialized skills (Chomsky, 1969).

Chomsky's (1969) findings indicate that acquisition of linguistic structures does continue beyond the age of five, that there is an orderly pattern, if variation, in rate of acquisition of these structures, and that differences in patterns of acquisition of these structures reveal distinctions in the structures themselves. This study provides valuable insights into language development and outlines a rather comprehensive but manageable methodology for

assessing children's competence for more complex linguistic structures.

Methods of Assessing Comprehension and Production of Grammatical Contrasts

Reports by Slobin (1967) and the Northwestern Syntax Screening Test designed by Laura Lee present additional approaches for assessing comprehension and/or production of various grammatical contrasts.

The Northwestern Syntax Screening Test (Lee, 1969) tests children's understanding and production of grammatical forms. The test was not devised for comprehensive evaluation of syntactic skills but to give an estimation of syntactic development to isolate children who may need training in language skills. Normative data is available for children aged three to eight. The test contains twenty pairs of receptive and expressive items with identical linguistic structures in both parts of the test. On the receptive items, four pictures are presented. The examiner says two sentences and the child is asked to point to the picture corresponding to each of the sentences. The expressive items use only two pictures. The examiner says two sentences, points to each picture in turn, and asks the child to say the sentence appropriate to each picture. The items range from four to seven words in length. Four items contrast pronoun usage, three contrast noun-verb agreement, two verb tense, three prepositional phrases, two passive

forms, two questions and one negative transformation. One contrast relates to object of the verb, one to use of this/that, and one contrast seems to involve auditory discrimination ("The boy washes himself" versus "The boy washes the shelf") although use of the reflexive pronoun is implied.

Although the test is only a screening device, there are only a few items which relate to transformational usage. Comprehension and production of the underlying structure of the sentence in many cases relies on a key word for the correct response. The test also seems to be useful only with children up to about age five. By this age, 90% of the children achieved scores of 32 or 33 out of a possible 40 on both expressive and receptive items. This raises the question as to the instrument's ability to detect problems in children over the age of five. Some of the contrasts seem to be more easily and directly represented--a problem with all tests of this type. The expressive task is a combination of production and imitation and therefore does not discretely assess children's ability to produce contrasts which may or may not be present in their spontaneous speech or their competence.

Slobin (1967) reports on several approaches which can be used to assess children's comprehension. One general technique is to give the child specific instructions to manipulate various objects in order to reveal his comprehension of the grammatical form. Slobin (1967) also reports

on a suggestion of Ursula Bellugi for determining comprehension of word order. Bellugi suggests constructing sentences to accompany pictured contrasts such as subject-object in both active and passive voice, reflexive-intensive, negative in main and subordinate clauses, etc. Results of these procedures are not available but are being used as part of a cross-cultural study of language development (Slobin, 1967).

Slobin (1967) also presents a number of techniques for eliciting various types of grammatical constructions. He suggests putting clothes on the wrong doll or puzzle pieces in the wrong place to elicit negatives. Retelling or telling a story is suggested, as this will give information about the child's productive system by the recoding which occurs in the retelling.

Slobin (1967) presents a number of elicitation techniques which were formulated by other investigators and contributed for use in the Field Study. Bellugi submitted five such tests. Bellugi's Negation test requires the child to say the opposite of what the examiner says. Her Interrogation test is designed to elicit structurally difficult or infrequently used questions. Dolls or puppets are used and the child is told to ask the doll questions in which the interrogative word, the noun phrase and auxiliary verb, the subject and object including the negative form of "why" questions are varied. Bellugi's Reflexivization test

requires the child to fill in the appropriate reflexive form after being given an example. Bellugi also submitted a Tag Question test which assesses children's ability to pronominalize nouns and noun phrases, to locate subject of a sentence, to handle conjoined noun phrases, to define sentence negation, to handle auxiliaries which the child may not produce, to locate the first element of an auxiliary verb, and to handle subject-verb agreement, tense agreement, etc. Bellugi's Transformation test involves interaction of two examiners with the child. Each examiner produces a different model sentence. The child is then given a sentence of one type and asked to produce a sentence of the other type. The test items include wh-questions with noun phrase object, separable verb and noun phrase object, active-passive transformation, and conjunction (Slobin, 1967).

Although Bellugi's tests for eliciting various grammatical structures are limited in number of items presented and lack data both on their usefulness and success with children, they are important in that they present additional approaches which may be valuable in assessing children's comprehension and production of various kinds of linguistic data.

The studies and methods of assessing comprehension and production thus far detailed present some useful data and possible techniques for measuring children's language

performance and competence. The approaches which rely on pointing responses present problems, some of which have been noted. The contrasts which can be assessed in this manner must be limited to items that can be represented pictorially and that differ by only one grammatical element. Thus, the investigators are restricted to studying less complex items. Results on simpler aspects of grammar do not allow for generalization to more complex grammatical constructions. Many uncontrollable variables are involved if longer and more complex sentences are used, even if the problem of how to picture the more complex relationships is solved. These approaches are also hampered by the inability to picture the same grammatical relationship in more than one item or in a hierarchy of items of increasing complexity. A single item is insufficient for drawing conclusions about a child's comprehension and/or production of that element and cannot be used for any developmental study of the emergence or increased complexity in understanding and producing a particular grammatical form.

Elicited Imitation as an Experimental Technique for Assessing Linguistic Competence

Slobin (1969, pp. 10-11), states that "a major advance with age is the increasing ability to program longer and more complicated utterances"; and that "increasing sentence-programming span appears to be one major determinant of the growth of linguistic complexity with age."

Slobin is one of the major researchers using elicited imitation as a way to study language acquisition. He feels that imitation is not an important device in language acquisition because it is unable to account for children's ability to comprehend and produce novel utterances. Slobin (1968a) believes that imitation plays many different roles in the process of language acquisition depending on the age of the child. Adult imitation and expansion of a child's utterance may help the child expand his own system of rules. Expansion and imitation of adult speech may allow the child to add items normally missing in the child's speech. Slobin (1968a) feels that expansions can extend a child's sentence programming span not merely by adding length but by increasing the number of operations needed to generate a construction. Slobin (1968a) also points out that there is no evidence that adult expansion plays a role in facilitating language development but believes that it still may help the child learn about the structure of his language.

Lenneberg (1964, 1967) also states that imitation is not a crucial factor in learning to comprehend or produce language. Lenneberg (1967) does feel that imitation of sentences is a useful way to test understanding because if understanding is deficient correct repetition becomes difficult. Based on his analysis of the language development of a group of retarded children, Lenneberg (1967) concludes that correct sentence repetition is based on comprehension

of the sentence, not sentence length, that errors made on repetition reflect the level of rule development needed to generate the sentence, and that correct reproduction of a sentence depends on knowledge of the rules not on rote memorization.

Ervin-Tripp (1966, p. 80), concurs with this position and states: "Imitations seem to be affected by the comprehension of grammar, child's storage capacities and his generative programming rules and complexity limitations." She also believes that correct reconstruction of a long sentence means it has been recoded correctly (Ervin-Tripp, 1966).

Studies Using Elicited Imitation

The traditional use of elicited imitation and the possibility of using this approach to determine linguistic competence is summarized by Mildred Berry:

> Memory span has been tested generally by the recall of single phonemes or nonsense syllables. If a child remembers cues on phonological, syntactic and semantic carriers, recall of meaningful sentences and short stories would seem to be a more valid assessment of a child's competence. (Berry, 1969, p. 151)

A. Epstein (1964) also points out that it is more useful to know the extent to which children can repeat utterances of their language than their skill in repeating digits or nonsense material.

There is little available data on auditory memory span for sentences to indicate the length of sentence a

child of a specific age should be expected to be able to repeat. Doctoral studies by Spencer (1958) and McGrady (1964) present results of a test of auditory memory for sentences given to children aged 2.6 years to six years (Spencer, 1958) and from age 7.6 years to 9.6 (McGrady, 1964). The test includes twelve sentences ranging in length from three to fourteen words. Median scores on recall of sentences increase with age and range from a score of 1.5 at age two and one-half, to 8.5 at age six, to 9 at age seven and one-half and a score of 12 at age nine and one-half. This test of sentence recall, however, does not control for sentence complexity, does not have the same number of items of each sentence length, does not give alternate items of the same length and type in case of failure, nor does it have sentences representing each length within the three to fourteen word range.

A. Epstein (1964) presented an extensive discussion of auditory memory for language in normal children and those with language delay. Three tests of auditory memory were used: two tested memory for meaningless syllables and one tested memory for sentences. The length of sentence was counted in syllables. His results, somewhat difficult to interpret, indicate that up to a certain length all short sentences are correctly reproduced. The normal children are able to repeat sentences whose length ranges from 12 to 20 syllables in grade two, 12 to 22 in grade three,

15 to 26 in grade four, 16 to 27 in grade five, and 17 to 27 in grade six. Although not analyzed by Epstein, it does not appear that this test shows significant differences at the different grade levels. There seem to be great similarities in both basal and ceiling levels. Epstein (1964) found lower scores for children with language delay, as one might expect. However, the children with language delay showed a wide range of IQ scores, and as the IQ scores approach normal (100) so do the scores on the sentence repetition test. This would indicate that the intelligence factor, either in combination with language delay or as a separate element is the determiner of success in sentence repetition. The test does not appear to separate the children with language delay on any other dimension.

While Epstein (1964) indicates the importance of auditory memory, he is content to count syllables and to disregard any role sentence structure may play in the repetition of sentences. His data on language delayed children yield little valuable information, since there was a great range not only in age, but in IQ and test results.

Although there may be other references in the literature to the importance of auditory memory in facilitating language development or contributing to language delay, no other studies are available which provide age-expected levels at which children are able to repeat sentences of specified lengths. The psycholinguistic studies on elicited

imitation, while not totally solving the problem, do provide information on the relationship of auditory memory for sentences to language acquisition and development. These studies also stress the importance of comprehension or recoding of sentences for correct reproduction.

Brown and Fraser (1963) had six children (24 to 36 months of age) repeat thirteen sentences. The sentences ranged in length from three to six words (an average of 5.2 morphemes) and were of various adult forms (question, negative, and imperative sentences). The number of morphemes these children could repeat is 2.2 morphemes at 25 1/2 months, 3.1 morphemes at 28 1/2 months, 3.7 at 30 months, 3.5 at 31 1/2 months, 5.0 at 32 months, and 4.9 morphemes at 35 1/2 months. These elicited imitations indicate that with increase in age more of the imitations are morphemically identical to the model sentences and include a greater number of the morphemes presented. The morphemes are always in the original order. Omissions are not random but show a tendency to drop one kind of morpheme and retain another. Morphemes likely to be retained tend to be in sentence final position, to be reference making forms, to belong to the large and expandable noun, verb, or adjective parts of speech, to be relatively unpredictable from context, and to receive heavier stress. Morphemes likely to be omitted tend to occur in sentence intermediate position, to belong to less important grammatical categories, to be non-reference

making forms, to be relatively predictable from context, and to receive weaker stress (Brown and Fraser, 1963). Brown and Fraser (1963) conclude that children's reduction of adult sentences is due to a limited auditory memory span and to a limited sentence programming span. They further state that span limitations probably compel the child to reduce adult sentences, but do not explain the tendency to drop or retain a specific type of morpheme (Brown and Fraser, 1963).

Freedle, Keeney, and Smith (1970) had children (mean age 4.4 years) imitate sentences of similar structure but different semantic content in order to test Brown and Fraser's (1963) conclusion that children omit function words and unstressed parts of a sentence. The sentences contained grammatical and ungrammatical sequences and ranged in length from five to seven words. The results indicate that sentence grammaticality is the predominant factor in the children's deletion of articles and verb inflections, but it is not the factor in deletion of noun inflections. Freedle, Keeney, and Smith (1970) conclude that the Brown-Fraser hypothesis is generally supported by the type of deletions the children in this study made. However, they do not feel that limited memory span alone can account for the pattern of errors in the children's imitations. Differential stress and low information value may also be important factors in children's repetitions.

Freedle, Keeney, and Smith (1970) also analyzed the results in terms of sentence mean depth. This analysis demonstrated that the mean depth measure cannot account for the relative difficulties the children experience in recall of the sentence.

Scholes (1970) had children aged three to four and one-half imitate strings ranging in length from three to five words. Some of the strings were well-formed, some were semantically anomalous, and some were syntactically deviant. Both real and nonsense words were used. The results show that children delete functors and retain contentives when imitating. Scholes (1970) hypothesizes that the child identifies and retains content words primarily on the basis of familiarity of form and to a lesser extent on the basis of knowledge of semantic structure.

Menyuk (1963b, 1964a, 1965, 1969) studied children's ability to imitate sentences containing structures found in child language samples. In her first study (1963b) nursery school and kindergarten children were asked to repeat actual sentences representing transformations found in a language sample of children of this age range. The children were also asked to repeat sentences containing forms restricted to the children's grammar. Sentences representing twenty-seven different transformations, ranging in length from three to nine words were presented. The results show that a significant number of nursery school children are

able to repeat all the transformations correctly but have difficulties repeating transformations of question, got, auxiliary have, conjunction with so and with because, and nominalization. The kindergarten children can repeat all transformations except for got and auxiliary have correctly (Menyuk, 1963b).

The restricted forms presented for repetition included 31 different sentences, each representing a different error. These ranged in length from two to eight words. Only 13 of the items were repeated correctly in the younger children and 23 in the older. Most non-repetition was due to correction of the restricted form. A significant number of the younger children corrected verb-form omission, tense agreement in conjunction, contraction deletion, preposition omission, and noun phrase omission. In the older group, the items corrected were contraction deletion, particle redundancy, and preposition omission (Menyuk, 1963b).

Menyuk (1963b) concludes that sentence length (two to nine words) is not critical in determining success in repetition. Differences in ability to repeat sentences are due to rule usage rather than to a more automatic repetition of structures. Children are able to imitate structures which they do not use spontaneously. Menyuk (1963b) assumes this is an indication that the child has incorporated the rules of the grammar under which he operates when understanding and producing sentences.

Menyuk (1965) replicated her earlier study and found essentially the same results. The sentences used in this study represented those transformations least used and most often modified by the younger children in the previous (1963b) study. The modifications the children make on repetition represent a set of rules more elementary or found earlier in the children's grammatical system. The results again support the finding that repetition is dependent on structure rather than length (Menyuk, 1965).

Menyuk (1964b) also compared normal speaking children and children with infantile speech in their ability to repeat sentences. The normal group correctly repeated more items. The imitations of the infantile speech group contained more omissions. They tended to repeat the end of a sentence or to apply general rules in processing and reproducing the sentences (Menyuk, 1964b).

Menyuk (1969) states that the differences in the ability of her subjects to repeat correctly is due to particular rules used to generate sentences, not to sentence length. Modifications of repetitions are also rule governed in that all modifications use simpler constructions than those in the target sentence. Many of her subjects use the same rules for reproducing and spontaneously producing sentences. Use of rules is also seen in the spontaneous corrections children make of ungrammatical sentences (Menyuk, 1969). Menyuk concludes:

> Repetition, therefore, in conjunction with analysis of spontaneous generation, seems to be a technique that can be used for eliciting information about level of grammatical development. It gives us information about the kinds of structures the child has acquired and those that he is in the process of acquiring and the level of acquisition of those structures that he is in the process of acquiring. More importantly, the results of these studies indicate that the child does not listen passively to the language in his linguistic environment, attempting merely to reproduce only what he can remember of what he had heard, but, rather actively goes through a process of matching what he hears to structures that he has internalized in order to regenerate or generate sentences. (Menyuk, 1969, p. 118)

Menyuk (1969) indicates the need for further research on imitation, making the suggestion that memory capacity for syntactic sequences which vary in both length and complexity be studied.

Menyuk's data on repetition have several limitations. There is no control of sentence length and no more than one item is given for testing a particular structure. Her data on restricted forms, however, present another fruitful method for studying linguistic competence.

Graham (1968) studied the ability of retarded children to repeat unstructured strings of words (two to six in length) and sentences which used 24 major transformations, each represented by one eight-word sentence. The results indicate that all subjects use sentence structure to facilitate recall. Both sentence type and short term memory significantly affected recall. Graham (1968) feels that these results support the theory that comprehension of

sentence structure is important in processing and imitating sentences. The underlying rules, which affect length of sentence derivation, must have caused the differences in performance between sentence types. The errors the children make in repetition are generally to produce a sentence nearer to kernel structure (Graham, 1968).

Salzinger, Salzinger, and Hobson (1966) studied children's ability to repeat sentence of varying syntactic structure. Three to six year old children repeated four-word (short) and six-word (long) sequences. The sequences were either intact declarative sentences or sequences containing one of the following reversals: reversal of subject and predicate, of verb and object, of noun and modifier, or of entire sentence. Age differences were found to be significant in that scores increase with age and imitation is best for the intact sentence. The scores for the mutilated sentences showed the following sequence in order of easiest to hardest to recall: subject-predicate reversal, verb-object reversal, noun-modifier reversal, and poorest scores for complete sentence reversal. The authors interpret their results as demonstrating that preschool children are sensitive to syntax and that they may use it to reduce the number of units to be encoded (Salzinger, Salzinger, and Hobson, 1966). The order of changes in structure probably reflects the frequency of these structures as units in English. The authors also indicate that there is some

evidence that the verb structure becomes increasingly important in recall as the sentence length increases beyond the memory span. They also conclude that these results are compatible with the coding hypothesis and could be further tested by varying sentence length more extensively (Salzinger, Salzinger, and Hobson, 1966).

Slobin (1967) suggests that elicited imitation is an excellent way to assess linguistic competence. The model sentences given for imitation should be designed to reflect the range of sentences typical to child speech, should vary in grammatical form, intonation and stress patterns, and should range in length from two to eight morphemes. He also suggests that some sentences should be successively increased in length so that the nature of errors made can be analyzed to shed further light on linguistic competence.

> It is especially valuable to ask the child to imitate sentences which seem to exceed his productive capacity, allowing for revealing alterations imposed on the model sentence by the child's own system of grammatical rules. (Slobin, 1967, p. 22)

Slobin and Welsh (1968) discuss the results of a longitudinal study of controlled imitation of one subject known as "Echo." One thousand elicited imitations were collected from the time Echo was 2.3 years to 2.5 years. Slobin and Welsh (1968) found that the number of words or morphemes did not indicate how much of a sentence Echo could imitate. She was able to imitate successfully both

long and short sentences and could produce spontaneously sentences she was unable to imitate.

Slobin and Welsh (1968) found that hesitation pauses and stress in the model sentence were important cues to sentence processing and could lead to alteration or insertion of new material on repetition. They also found that Echo ignored repeated words in the model sentence unless the words were interpretable as an appropriate lexical item. For example, Echo said "I need the ball" when asked to repeat "I need need the ball," but imitated exactly when asked to repeat "I need the ball ball," where "ball" could be an appropriate item to say twice.

The authors believe that when a child repeats a sentence it is filtered through the child's productive system (Slobin and Welsh, 1968). The recoding the child does when imitating corresponds to the linguistic system the child is in the process of learning. Slobin and Welsh (1968) found that Echo repeated some sentences with word substitutions. Her substitutions preserved the meaning of the sentence indicating that the meaning had been understood and recoded in a new form. The data on Echo contradict the generalization that the order of elements is preserved in imitation. Presented sentences which were conjoinings of two underlying sentences, both of which Echo understood, were frequently inverted on repetition. This inversion indicates comprehension of "and" as a sentence conjunction. Echo's

imitation, as shown by the inversion of conjoined sentences, suggests that she has a strategy which retains the general syntactic form of the model and produces something which follows this general form. Parallel constructions thus occur without retention of the exact content words and structural details (Slobin and Welsh, 1968).

By constructing sentences with complex transformational histories, Slobin and Welsh (1968) found evidence that Echo looked for subject-verb-object relations in the model sentence. The order was not necessarily preserved in these imitations, but it seems that Echo was attempting to extract subject-verb-object constructions based on her knowledge of both syntactic and semantic markers. Echo was able to imitate exactly ungrammatical or anomalous sequences if they were short enough. This again emphasizes the importance of memory span in using elicited imitation as a way to study competence.

Slobin and Welsh (1968) conclude that careful study of elicited imitation is a fruitful method for studying linguistic competence and development. They state:

> The process of sentence recognition includes retrieval of both form and content. Syntactic structures take up space in memory and frequently content will be sacrificed to the retention of form in immediate, rote imitation. On the other hand, if content has been retrieved and stored, it may be encoded in the child's own syntax in imitation.
>
> A fine grained analysis of repeated imitations of systematically varied model sentences can reveal aspects of the child's theory of syntax including transformational rules and the syntactic and semantic markers borne by lexical items. (Slobin and Welsh, 1968, pp. 17-18)

The studies on elicited imitation show that there is a pattern to the imitations based on limitations of children's immediate memory span, sentence programming span, and knowledge of linguistic rules. The studies also indicate that analysis of errors children make when attempting to repeat sentences beyond their level of development has the potential to provide much valuable information about the development of linguistic competence.

A recent study by Jon Miller (1970) investigated the effect of surface structure complexity, transformational sentence type and sentence length on a sentence imitation task. Twenty pre-school children aged 4.8 to 5.5 were tested on sentences which varied in high and low Yngve depth, that is, four transformational types (active, negative, passive and wh-questions) in sentence lengths of five through nine words. Miller (1970) finds that sentence length is predictive of difficulties children have in repeating the sentences. Neither surface structure complexity (Yngve depth) nor transformational complexity can predict accurately the difficulties children had in this elicited imitation task. Miller (1970) also finds that the order of difficulty of sentence recall is not in the order predicted by grammatical rules. For the low Yngve depth sentences, the question sentences are easiest to recall, with active, negative and passive sentences almost equal in difficulty, but with the negative form being slightly easier. Active

and negative sentences are easiest for the high Yngve depth sentences, again with the negative form being slightly easier, followed by wh-questions, and with passive sentences causing the greatest difficulty. Miller (1970) points out the difficulties in accurately constructing sentences of equal transformational difficulty and with the specified Yngve depth measures. These results suggest that surface structure complexity is not useful in modifying sentences on elicited imitation tasks. Miller (1970) suggests further studies controlling sentence length and perhaps modifying other transformational complexities in order to assess linguistic development in children.

Studies Comparing Imitation, Comprehension and Production of Sentences

A number of investigators followed the experimental technique of Fraser, Bellugi, and Brown (1963) to compare children's imitation, comprehension, and production of various grammatical forms.

The study of Fraser, Bellugi, and Brown (1963) was stimulated by the familiar statement in the literature that comprehension of language (passive control) occurs earlier in development than production of the same feature (active control). They devised a test built around pairs of sentences which contrast a single grammatical feature. The sets of pictures were the same in terms of object, action, and qualities, but differed in aspect and time of action,

spatial relations between objects, and in number of creatures performing the action. The child pointed to the picture named for the comprehension (C) task. The production (P) test required the child to produce the sentence appropriate to a given picture. The child was also asked to imitate (I) the contrasting sentences. Twelve children ranging in age from 37 to 43 months were tested.

The results indicate that for every grammatical contrast, comprehension is better than production. Imitation surpasses comprehension in nine of the ten contrasts and is also better than production. Fraser, Bellugi, and Brown (1963) point out that factors such as perceptual obviousness of the contrast, length of total sentence, and frequency of exposure to a particular construction may have affected the results. They feel that since imitation is better than comprehension, it may be that imitation is a perceptual-motor skill which does not depend on comprehension and that the highly systematic speech system is under more complete control at three years than the less systematic referential system (Fraser, Bellugi, and Brown, 1963). These results support the assumption that passive control is achieved earlier if the production and not the imitation results are used. Fraser et al. (1963) do point out that the imitation task may have been too easy probably falling well within the sentence programming span of three year olds. These authors hypothesize that younger children, with shorter

spans, should be compelled to reduce model sentences when imitating (Fraser, Bellugi, and Brown, 1963). If they do omit words on imitation but correctly point to the contrasts, this indicates that they can internally process more than they can produce (provided that the previously mentioned limitations of the contrasts do not affect the response).

McNeill (1966b) discusses these results and believes that the child's performance will depend on the length of sentence in relation to the size of the appropriate memory span. He hypothesizes that there are at least three spans, the largest of which is phonological. Grammatical comprehension span is next. Grammatical production span is the smallest. The relationship of these spans is stated by McNeill as the following principle:

> If a sentence is shorter than a given span, the corresponding performance can occur; if a sentence is longer than the memory span, the corresponding performance cannot occur with complete accuracy. (McNeill, 1966b, p. 79)

McNeill goes on to hypothesize four relations among imitation, comprehension, and production which are dependent on sentence length:

> 1. If sentences are short in relation to the grammatical production span, imitation, comprehension and production should be equivalent because underlying competence-phonological or grammatical--can be expressed in every task.
>
> 2. If sentences are long in relation to the grammatical production span but short in relation to the grammatical comprehension span, comprehension and

> imitation should be equivalent, and both should be superior to production.
>
> 3. If sentences are long in relation to both the grammatical comprehension and production span but short in relation to the phonological production span, imitation should be superior to both comprehension and production, which in turn should be equivalent.
>
> 4. If sentences are long in relation to the phonological production span, all three types of performance--imitation, comprehension, and production--should again be equivalent because underlying competence is not likely to be expressed in any task. (McNeill, 1966b, p. 79)

McNeill (1966b) feels that this scheme accounts for the apparent contradiction between the findings of Fraser et al. (1963) and those of Ervin (1964). Ervin's (1964) findings were probably based on relationship number four above where the children probably recoded adult sentences before repeating them. The subjects of Fraser et al. (1963) were older and were given short sentences so that the results probably reflected relationships two and three above, where imitation exceeds production (McNeill, 1966b). These results are difficult to compare, however, since Ervin (1964) used spontaneous imitation and Fraser et al. (1963) used elicited imitation.

Lovell and Dixon (1967) used the technique of Fraser et al. (1963) to trace the growth of imitation, comprehension, and production in normal and retarded children aged two to six years. The findings of Fraser et al. (1963) of I > C > P were confirmed for the whole age range and for both groups of children. Maximum scores were obtained by most

of the normal children on the imitation by age four. There was little increase in scores on the comprehension and production tasks between the ages of five and six (Lovell and Dixon, 1967). These results support the technique, but the fact that maximum scores on the imitation test are achieved in the younger children indicates that the test items do not increase enough in difficulty to measure development of this skill.

Lovell, Hoyle, and Siddall (1968) also used the ICP method to analyze ten normal children and ten with delayed speech at ages three and four. No significant differences were found between the groups on the comprehension items, but significant differences were found between the groups on the other two tasks. The children with delayed speech showed scores for comprehension which exceeded imitation, while the normals showed the reverse. The analysis of spontaneous speech of the children indicates that the delayed speech group is limited not only in quantity of speech, but that their linguistic system can be described as less complex and analyzable in terms of phrase structure rules alone (Lovell, Hoyle, and Siddall, 1968).

Turner and Rommetveit (1967a) also used the ICP technique to assess the ability of nursery through third grade children to handle reversible and non-reversible active and passive sentences. All sentences were five words long. The results show that children can correctly

respond to the comprehension task before they are able to produce the sentence. Active sentences are more correctly responded to than passives, and non-reversible sentences are easier than reversible forms. Sentence voice was found to have a more significant effect than reversibility. More errors are made on the comprehension task than the imitation task and more errors are found in production than in comprehension (Turner and Rommetveit, 1967a).

This study suffered from the same problems as the previously mentioned studies in that the imitation task was too easy for the age group. Sentences given for imitation which are too short most likely do not have to be recoded for correct repetition. These short sentences do not reveal the child's linguistic competence since the material does not have to be processed for correct imitation.

Conclusions

The foregoing review of the literature attempts to outline the areas of research, the theoretical foundations, and the experimental approaches used in studying the acquisition, development, and usage of linguistic systems. Results and hypotheses have been presented concerning linguistic competence, performance, and sentence processing strategies of children and adults. The evidence from both child and adult studies supports the usefulness of transformational theory and, to a great extent, confirms the coding hypothesis. Sentential material was shown to be perceived,

learned, recalled, and acquired according to linguistic rules.

This review has also presented a discussion of the techniques which have been used for studying language development and usage. Some of the limitations of these techniques were noted. The descriptive studies of children's performance presented numerous items of what children say and allowed for formulation of tentative hypotheses about children's linguistic competence. Various other approaches for assessing both competence and performance were described. The studies using elicited imitation seem to reflect the child's competence most directly and to permit description of the development of this competence most adequately. Careful control of the sentential material given for imitation and careful analysis of the child's responses and errors in producing the sentences, should provide reliable information about linguistic competence and performance at each stage of language acquisition.

CHAPTER III

PROCEDURES

In this study, forty normal pre-school children were given the Test of Auditory Memory Span for Sentences.

Subjects

The children used in this study ranged in age from three to five years with ten children in each six month age group within the two year span. The entire population consisted of twenty males and twenty females distributed so that within each six month age group there were five males and five females.

All the children were enrolled in the following four private nursery schools: The Queens School, the Valentine Cooperative Nursery School, the Parkway Village Nursery School, and the Flushing YM-YWHA Nursery School. All testing was done in this setting.

No child who had a history of multiple articulation problems, language problems, bilingualism, hearing loss, behavioral, physical, or intellectual problems was accepted for this study. Reports by the teachers and principals, school records, and observations of the children playing in

the classroom were used to rule out the presence of any of the above problems.

The Instrument

The construction of the Test of Auditory Memory Span for Sentences involved varying sentence length and sentence complexity. The test is made up of eight sub-tests, each sub-test containing twenty sentences. In each sub-test, all sentences are of the same basic grammatical type but increase in length from three to twelve words with two sentences of each length. The sentence types used as the basis for the eight sub-tests are based on Miller's (1962) hypothesized relationship of the seven complex sentences to SAAD sentences. Sub-test I contains twenty simple, active, affirmative, declarative (SAAD) sentences. These twenty sentences are transformed into Passive (P) for sub-test II, into Negative (N) for sub-test III, into Question (Q) for sub-test IV, into Negative Passive (NP) for sub-test V, into Negative Question (NQ) for sub-test VI, into Passive Question (PQ) for sub-test VII, and into Negative Passive Question (NPQ) for sub-test VIII.

Selection of Words

All words used in the test were selected from the Thorndike-Lorge (1944) lists. All words used were rated AA, indicating that they occur 100 times or more per million words. The particular AA words selected were further marked

by an M in the J column, indicating that they occur 1000 times or more in children's books.

The nouns and adjectives chosen from the lists were felt to be appropriate for this age group, to be semantically sensible in all sentence types, and contained no more than three syllables. The articles, prepositions of location, and pronouns were selected according to these criteria as well.

All verbs used in the sentences were transitive so that they could be transformed into P, NP, PQ, and NPQ form. In each set of two sentences of each sentence length, one verb form was regular and one was irregular. The verb in the first of the two sentences was in the simple present tense, in the second of each set the verb was in the simple past tense. The regular and irregular forms were alternated in each set of two sentences of each length so that there were equal numbers of present tense regular, present tense irregular, past tense regular, and past tense irregular verbs. The verb "to be" was not used as a main verb, only as an auxiliary verb.

Construction of Sentences

Twenty SAAD sentences were constructed using the types of words described above. These sentences were then transformed into the seven forms (P, N, Q, NP, NQ, PQ, NPQ).

Sentence length was increased from three to twelve words by adding adjectives and/or a prepositional phrase of location (as described below). These were selected on the basis of previous research which had indicated that children aged 2.6 use prepositional phrases of location and children aged 2.4 use adjective transformations (Menyuk, 1964b). Adjectives were added starting with the six-word SAAD sentence. As many as four adjectives were added for the twelve-word SAAD sentence. Adjectives were not added until the sentences were one or two words longer on the other sentence types. Prepositional phrases were added to form the eight-word and longer SAAD sentences. For the more complex sentence types where the grammatical form requires an increase in sentence length, one or more adjectives were deleted but the prepositional phrase was retained.

Sentence length was restricted by deletion and/or contraction transformations and/or by pronoun substitution for the first and/or second noun phrase. For the three- and four-word sentences, the by-phrase was deleted in the P, NP, PQ, and NPQ sub-tests. Contractions were used in the N, NP, NQ, and NPQ sub-tests and were counted as single words. Both contraction and deletion transformations were used in the NPQ sub-test. Pronoun substitution for either the first or second noun phrase was used on all sub-tests to restrict sentence length.

In order to illustrate the types of sentences used and the types of changes made to maintain length restrictions on the eight sub-tests, sub-test I (SAAD sentences) and sub-test VIII (NPQ sentences) are reproduced below. (The entire test appears in Appendix I. The numbers on the left refer to the number of words in each sentence.)

Sub-test I--Simple Active Affirmative Declarative Sentences

#words

3 1. He eats food.
3 1. She cooked dinner.

4 2. She cleans the room.
4 2. He broke the glass.

5 3. The boy sees the boat.
5 3. The girl closed the door.

6 4. The lady opens the red box.
6 4. The baby wore a blue dress.

7 5. The pretty girl finds the brown hat.
7 5. The black horse pulled the big tree.

8 6. She washes the white car in the country.
8 6. He drove the long train to the station.

9 7. The children draw a little picture on the paper.
9 7. The busy farmer in the yard watched the bird.

10 8. The fat lady moves the heavy chair across the floor.
10 8. The mother read the long story to the good boy.

11 9. The tall man catches the yellow fish under the large rock.
11 9. The happy family played the whole game in the green grass.

12 10. The bad boy drops the cold milk on the clean kitchen table.
12 10. The rich man bought the short gray coat in the new store.

Sub-test VIII--Negative Passive Question Sentences

#words	
3	1. Isn't food eaten?
3	1. Wasn't dinner cooked?
4	2. Isn't the room cleaned?
4	2. Wasn't the glass broken?
5	3. Isn't it seen by him?
5	3. Wasn't it closed by her?
6	4. Isn't it opened by the lady?
6	4. Wasn't the dress worn by her?
7	5. Isn't the hat found by the girl?
7	5. Wasn't the tree pulled by the horse?
8	6. Isn't it washed in the country by her?
8	6. Wasn't it driven to the station by him?
9	7. Isn't a picture drawn on the paper by them?
9	7. Wasn't it watched by the farmer in the yard?
10	8. Isn't the chair moved across the floor by the lady?
10	8. Wasn't the story read to the boy by the mother?
11	9. Isn't the yellow fish caught under the rock by the man?
11	9. Wasn't the game played in the grass by the happy family?
12	10. Isn't the milk dropped on the kitchen table by the bad boy?
12	10. Wasn't the short coat bought in the new store by the man?

In order to eliminate the effect of order of presentation, forty different sequences of the eight sub-tests were randomly selected so that no child in any age group received the same order of the sub-tests.

Equipment

In addition to the test itself, a Wollensak 3500 solid state tape recorder was used to record all responses. Three hand puppets were also used to interest the children and to hold their attention. The puppets were soft, furry, and colorful and required only whole-hand manipulation of opening and closing the puppet's mouth. One puppet was a yellow duck, one was a black and white spotted pig, and one was a beige and red horse.

Testing Procedure

Each child was tested individually in a single session. Testing required thirty to forty-five minutes depending on the age of the child, his cooperation and attention, his speed of response, etc. Responses were noted during testing but all responses were recorded for later more exact analysis.

In each school, the examiner was first introduced to the children in the classroom setting. The examiner participated in the children's activities for a short period and then introduced the puppets to the group. The puppets were discussed (type of animal, sound each animal makes, etc.) and each child was allowed to play with a puppet for a few minutes. The examiner then took the puppets and explained to the class that these puppets were very silly because each could only say what the other one said. Examples of this behavior were given to the class. The examiner

then told the class that the puppets were going to play a game with some of the children by themselves. The children were selected (according to the criteria described above) and taken one at a time to another room for testing.

For the individual testing, each child was allowed to select whatever puppet he wanted to use for the game. The examiner chose another puppet, usually according to the child's directions. During testing, the child was permitted to change puppets so that he could have a chance to play with all three at some point. This was done to maintain interest and attention throughout the testing. The use of the tape recorder was also explained to the child who was told that when the game was finished he could hear himself on the tape.

Instructions were given to each child as follows. "We are going to play a special game with our puppets like I showed you in class. My puppet is going to say some things and whatever my puppet says I want you to make your puppet say exactly the same thing. Remember, your puppet can only say what my puppet says, he can't say anything on his own. Suppose my puppet says: 'I sit in a chair.' What does your puppet say? (Child responds.) Good. Suppose my puppet says: 'How are you?' What does your puppet say? (Child responds.) Very good. O.K. Are you ready to play the game?" The latter example was given to allow the child to have an opportunity to repeat a question, not

answer it. If the child answered the questions, he was told that was correct, but that his puppet did not know how to answer any questions. His puppet only knew how to ask my puppet the same question. For the children who answered the question in the example, another example was given, such as "How old are you?" "What time is it?" "Is it Monday?" When the child seemed to understand the task from the examples given to him, the examiner proceeded to give the Test of Auditory Memory Span for Sentences.

The examiner read each sentence aloud in a normal voice and using normal intonation patterns. The examiner tried to read each sentence in the same manner for each child.

The entire test (all eight sub-tests in random order) was given to each child. Each sub-test was given beginning with the three word sentence. Sentences were given in order of increasing length until each sub-test was completed or until the child did not respond at all to several successive sentences. Each sentence was given once. If a child correctly repeated one sentence of a particular length, the alternate sentence of that length was not given and testing continued with the next longer sentence. As explained earlier, the first sentence of each length is in the present tense, while the second is in the past tense. The examiner therefore, randomly presented either the first or second sentence of each length for the child to repeat. When a

child failed to correctly repeat a sentence, or when the child did not respond at all, the alternate form of that length was given and testing continued giving every sentence until the child failed to respond or until that sub-test was completed.

Occasional reminders to "say just what my puppet says" were given during testing as needed. A number of the children said "yes" or "no" for some of the longer sentences instead of repeating the sentence. This occurred for both question and non-question forms. When this occurred, the child was directed to "say it" or "say the whole thing."

When the test was completed, the child was allowed to listen to a short portion of the tape, and then was escorted back to his class.

Summary

Forty normal pre-school children were given the Test of Auditory Memory Span for Sentences. The children ranged in age from three to five years with five males and five females in each six-month age group within the total age range.

The test given to the children consisted of eight sub-tests, each sub-test containing twenty sentences. The sentences on each sub-test ranged in length from three to twelve words. The eight sub-tests consisted of sentences of eight different grammatical types. The first sub-test contained simple, active, affirmative, declarative sentences.

The other seven sub-tests contained sentences similar to those on the first sub-test but with negative, passive and question (and all combinations of these) transformations. The order of presentation of the sub-tests was randomized.

Each child was tested individually and all responses were tape recorded. The entire test was given to each child beginning with the three word sentence. Sentences were given in order of increasing length until each sub-test was completed or until the child did not respond at all to several successive sentences.

CHAPTER IV

RESULTS

This chapter presents a description of the methods used for analyzing the children's responses and the types of data available for analysis. The chapter then describes the five factor analysis of variance program and the results of this statistical analysis. The main effects of this analysis are presented first, followed by a presentation of the significant interactions of these effects. The final section of the chapter presents an analysis of the specific types of errors the children made on the sentences.

Analysis of the Data

Scoring of the Sentences

All subject's responses were transcribed from the tape recordings by the experimenter. Each sentence for each subject on each sub-test was scored as a percentage of the target words in the sentence which were incorrectly repeated by the child. Thus, a score of zero percent indicated that all words were correct and a score of 100 percent indicated all words in the sentence were incorrect. The sentence score did not account for errors of word order; that is, if a target word was correctly repeated by the child but was not in the correct position in the sentence, the child still

received credit for correct repetition of the permuted word or words. A child who did not attempt to repeat a particular sentence, received a score of 100% indicating all words in the sentence were incorrect. The sentence repeated totally incorrectly likewise received a score of 100%.

Tabulation of actual errors made by the children was also done. The errors were analyzed in terms of traditional parts of speech which were then grouped into three larger categories to be described below.

The Analysis of Variance

A five factor analysis of variance computer program was run on the percent error scores for each sentence. An arcsin transformation was written into the program so as to stabilize the variances for scores in percentage form.[1] An analysis of variance was computed for the following five factors at each of the ten sentence lengths (three to twelve words). Factor A referred to first or second attempt to determine whether there was a difference in the child's repetition of the two sentences of each sentence length on each of the eight sub-tests. Factor T referred to the eight sentence types. Factor S referred to subjects who were ranked according to increasing age in months within each six-month age group. Factor X referred to sex. Factor G referred to age groups

[1]Computer program was written and run by Prof. Harry Levitt, The City University of New York, who also advised on the statistical analyses in this project.

with four groups of five subjects each in each of the four six-month age levels from three to five years.

In order to determine the significance of the main effects and interactions for each of the analyses of variance, the highest order interaction (ATSXG) was used as the estimate of experimental error for factors A and T and all interactions involving A and T.[2] The SXG interaction was used as the estimate of error due to intersubject variability and was the interaction used to test the significance of the factors S, X and G main effects and of the SX, SG, and XG interactions.[3] The summaries of the analysis of variance for each sentence length and significance levels for each factor and all interactions appear in Appendix II.

Results

The percent error scores for each sentence for each child were analyzed by the five factor analysis of variance program. The results of this analysis are presented below.

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[2]When there are a large number of treatments and only one observation for each treatment, no estimate of experimental error corresponding to the within treatments mean square is available. With this type of design, the highest order interaction is assumed to be negligible and of little experimental interest and is therefore used as the estimate of experimental error (Edwards, E.A., Experimental Design in Psychological Research, N.Y.: Holt, Rinehart and Winston, Inc., 1962, p. 211).

[3]Personal communication with Prof. H. Levitt, CUNY. When comparing subject differences, such as age and sex, another estimate of error is needed to account for large intersubject variation. The SXG interaction is used as the estimate of error due to intersubject variability.

The five main effects are presented first followed by a discussion of the significant interactions.

Main Effects

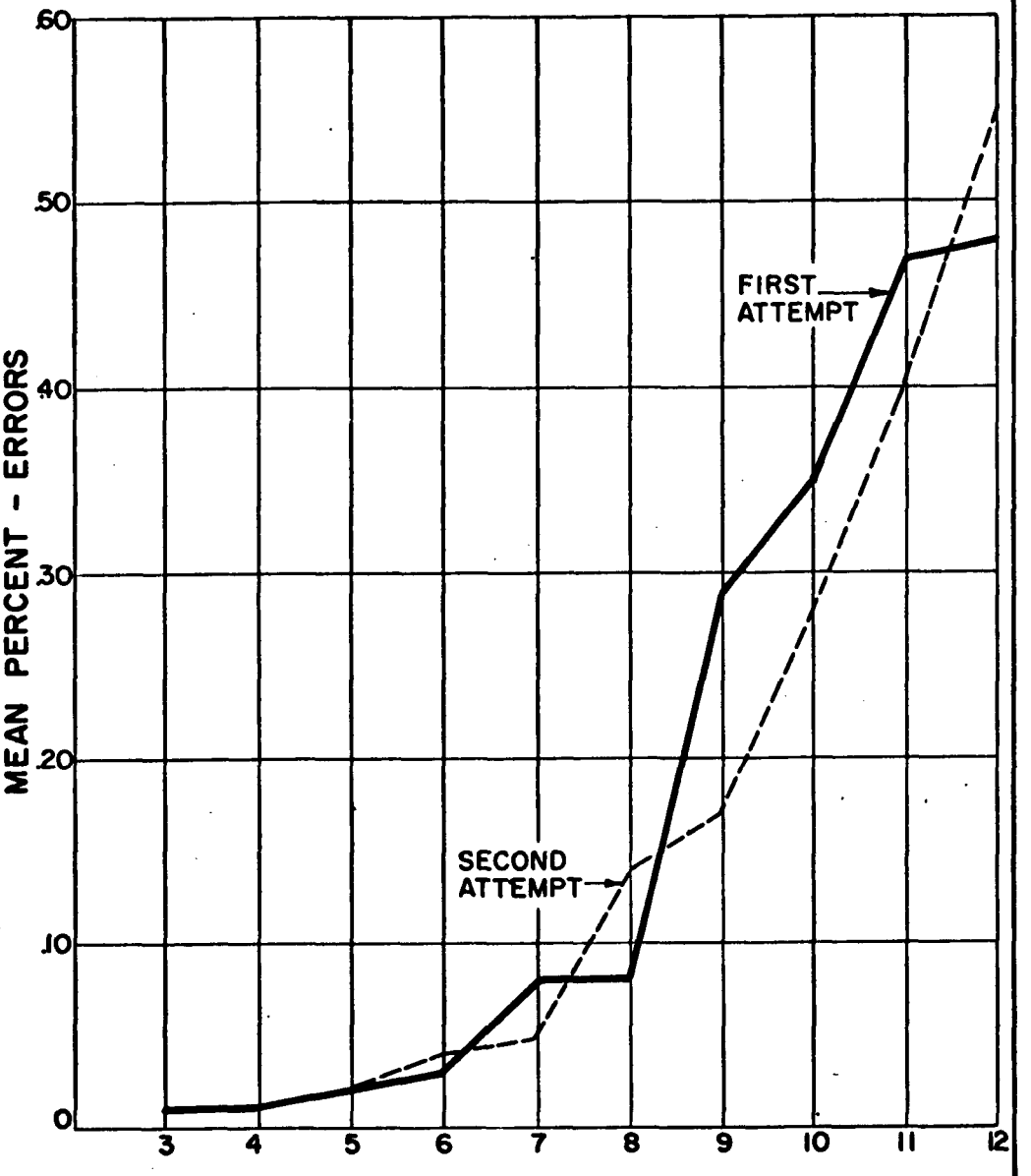
First or second attempt.--Factor A (Figure 1, p. 121) was not significant for sentence lengths three through six but was significant for sentence lengths seven through twelve. The F ratios for these sentence lengths (seven through twelve) were all significant at the .01 level of confidence except for the eleven word sentence which was significant only at the .05 level. The first sentence of each length was always in the present tense and the second was in the past, but the verb form of regular or irregular alternated between the A and B sentences of each length. The mean percent error scores show no differences for sentence lengths three, four and five. The first sentence for sentence lengths seven, nine, ten and eleven showed greater percent error scores. With the exception of sentence length ten words, all verbs were irregular present tense forms. The second sentence showed greater errors on lengths six, eight and twelve which were all both past tense and irregular forms of the verb. The analysis of this factor indicates that these children experienced greater difficulty with irregular verb forms, and to a lesser degree, more difficulty with past than present tense verbs. Since the verb type and tense was the major difference between form A and B of each sentence length, the significance of this factor can be attributed to effect of

the verb rather than to other factors, such as effect of order of sentence presentation.

Sentence type.--The mean percent error scores for factor T are represented in Figure 2, p.122.[4] The analysis of variance yielded F ratios significant at the .01 level for factor T at all sentence lengths except eleven words, indicating that grammatical structure is a significant factor in determining children's ability to imitate.

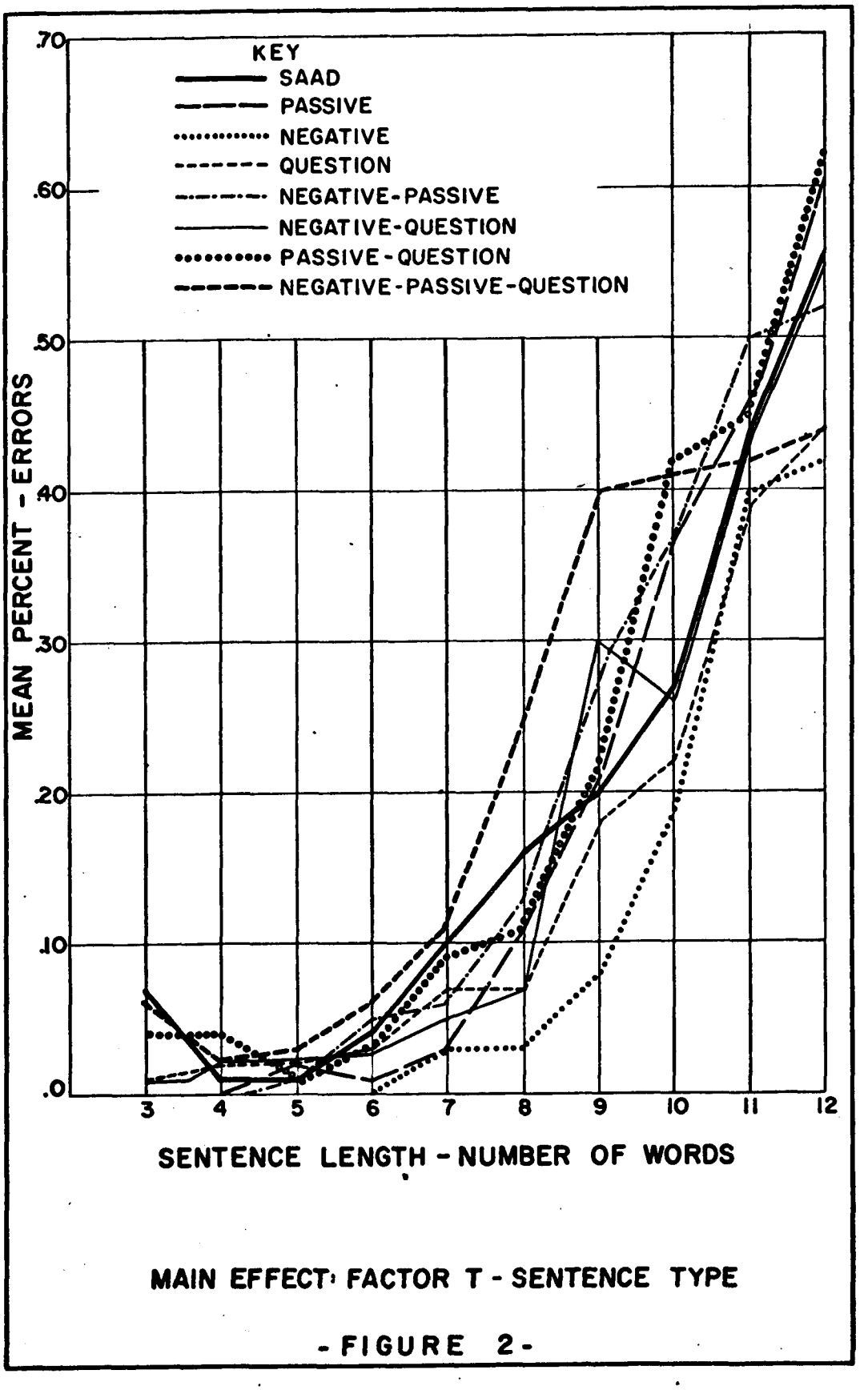
The mean percent error scores are very low for sentence lengths three, four and five and show an increase in percentage of errors at six words, followed by a steady increase in error rate to the twelve word sentence length. The predicted hierarchy of difficulty for sentence types, however, was not completely supported by the results. The one universal result was that negative sentences were easiest to repeat (showed the lowest mean error scores). This was true for all sentence lengths except for eleven word sentences where it was second in ease of correct repetition to question sentences. The predicted most complex sentence type, negative-passive-question, resulted in the largest number of errors for sentence lengths five through nine, and in the second largest number of errors for lengths three and ten words. However, for sentence lengths eleven and twelve, NPQ was among the three easiest types of sentences to repeat

[4]It should be noted that on all tables and figures SAAD sentences are cited as S.



MAIN EFFECT: FACTOR A - FIRST OR SECOND ATTEMPT

- FIGURE 1 -



MAIN EFFECT: FACTOR T - SENTENCE TYPE

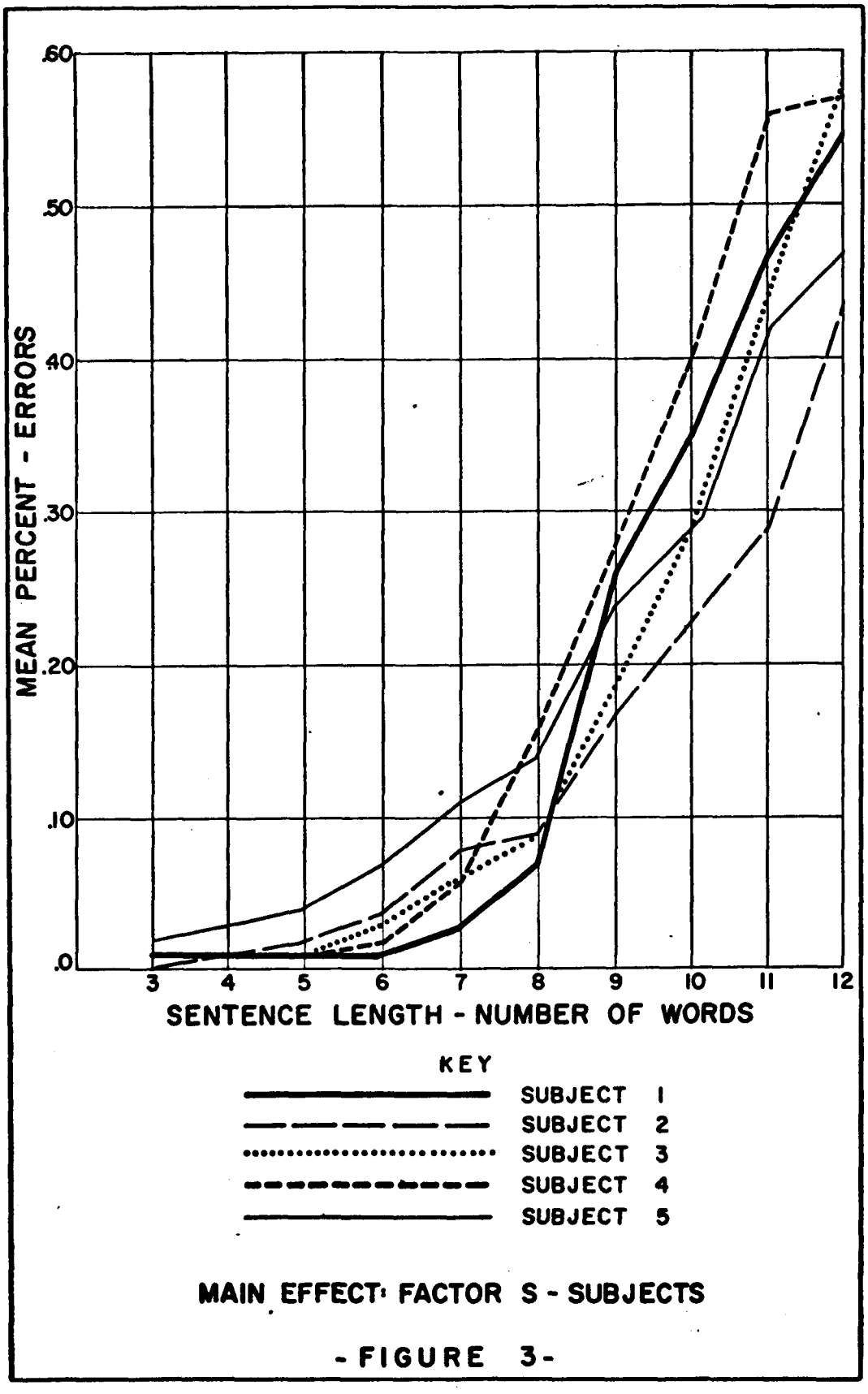
- FIGURE 2 -

(following Q and N sentences for eleven word sentences and second to N for twelve word sentences). The SAAD sentences, which were predicted to be the easiest to imitate, never received the lowest error scores and only for the five word sentences was it second in ease of repetition to the N form. SAAD sentences received ranks of difficulty (based on the mean number of errors) of three for nine word sentences, four for four and ten word sentences, five for six and eleven word sentences, six for twelve word sentences and seven for seven and eight word sentences. Thus, in no case was this the easiest form to repeat and in two cases (seven and eight word sentences) it was second in difficulty to NPQ, the sentence type predicted to be most difficult to repeat.

Negative, passive and question sentences, having one optional transformation in their derivations and predicted to be second in difficulty to the SAAD form, did not show the predicted effect consistently. The P and Q forms ranked generally between second and fourth in order of increasing difficulty with the exception of eleven and twelve word sentences where passive was second most difficult, and four and five word sentences where question was second most difficult. For the NP, NQ and PQ two-level optional transformation sentences, the rank order of difficulty was scattered between third and eighth position. Negative-passive tended to rank around third in difficulty for the shorter sentences and around sixth for the longer ones. There was no overall rank order of difficulty for NQ and PQ.

The overall effect of sentence type indicates that although the effect of type is highly significant at all but one sentence length, the predicted hierarchy of difficulty in terms of transformational complexity is not completely supported by the results. The single optional Negative transformation sentence was easiest to repeat and the triple Negative-passive-question transformation sentence was generally most difficult, although the effect of the latter was not consistent across all sentence lengths. It would also appear that seven to eight word sentences represent the beginnings of sentence processing since relatively few errors occur below this sentence length for all age groups. Slightly shorter sentences (six to seven words) for the 3.0 to 3.5 year olds and slightly longer sentences (eight to nine words) for the older groups appear to indicate the beginnings of errors and perhaps the beginnings of greater dependence on sentence processing strategies in terms of grammatical structure for correct imitation.

Subjects.--Factor S measured differences between subjects ranked according to increasing age within each age group and was not found to be significant at any sentence length. The graphic representation of this factor (Figure 3, p.125) does indicate low error rates for sentence lengths three through seven with a sharp and continual increase in mean percent errors for all subjects from eight to twelve words.



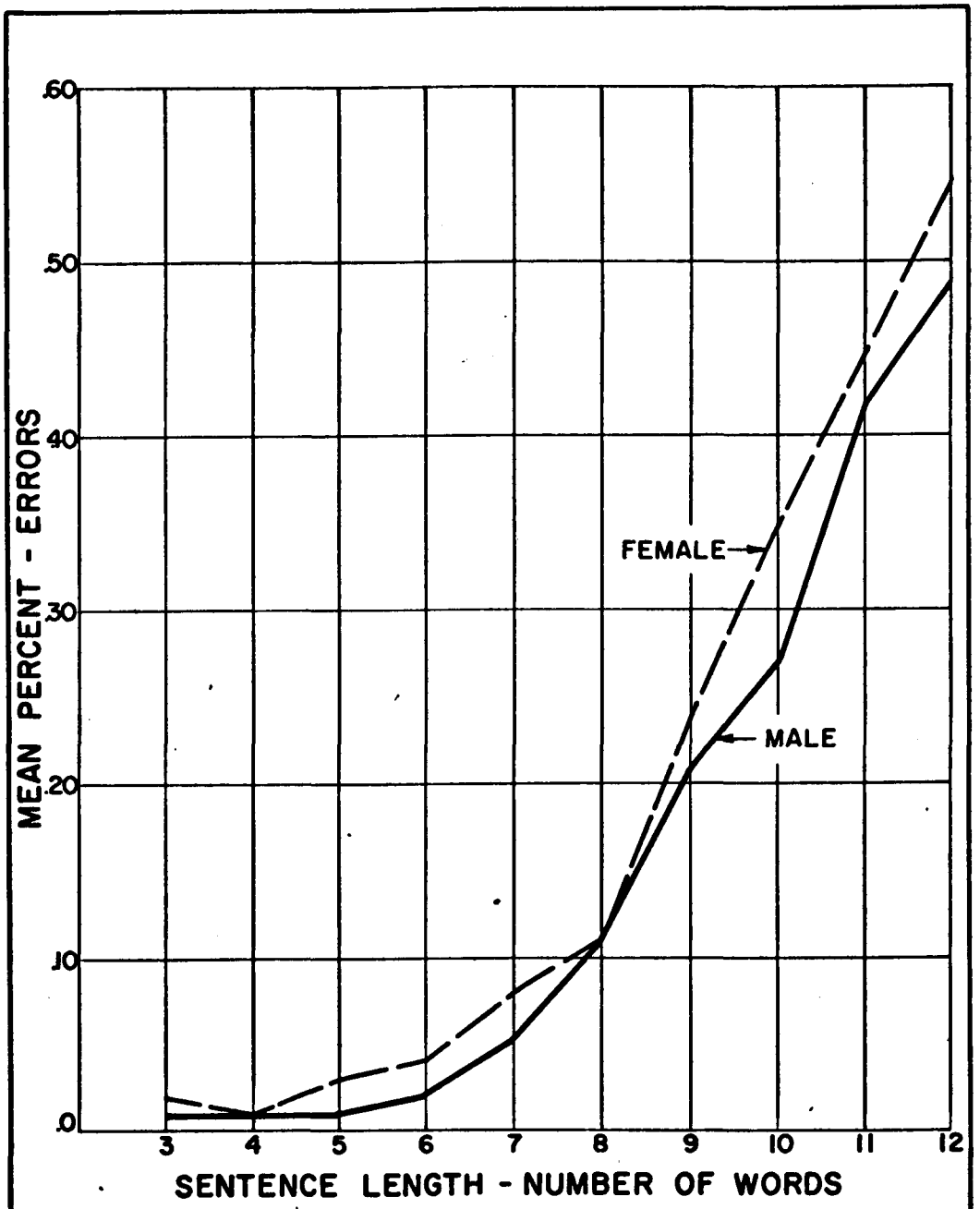
MAIN EFFECT: FACTOR S - SUBJECTS

- FIGURE 3 -

Sex.--Factor X was likewise not significant for any sentence lengths indicating no significant differences between males and females in ability to correctly imitate the sentences. The graphic representation of this main effect (Figure 4, p.127) indicates a slight superiority in favor of females for all sentence lengths. However, this difference is not statistically significant compared to intersubject differences.

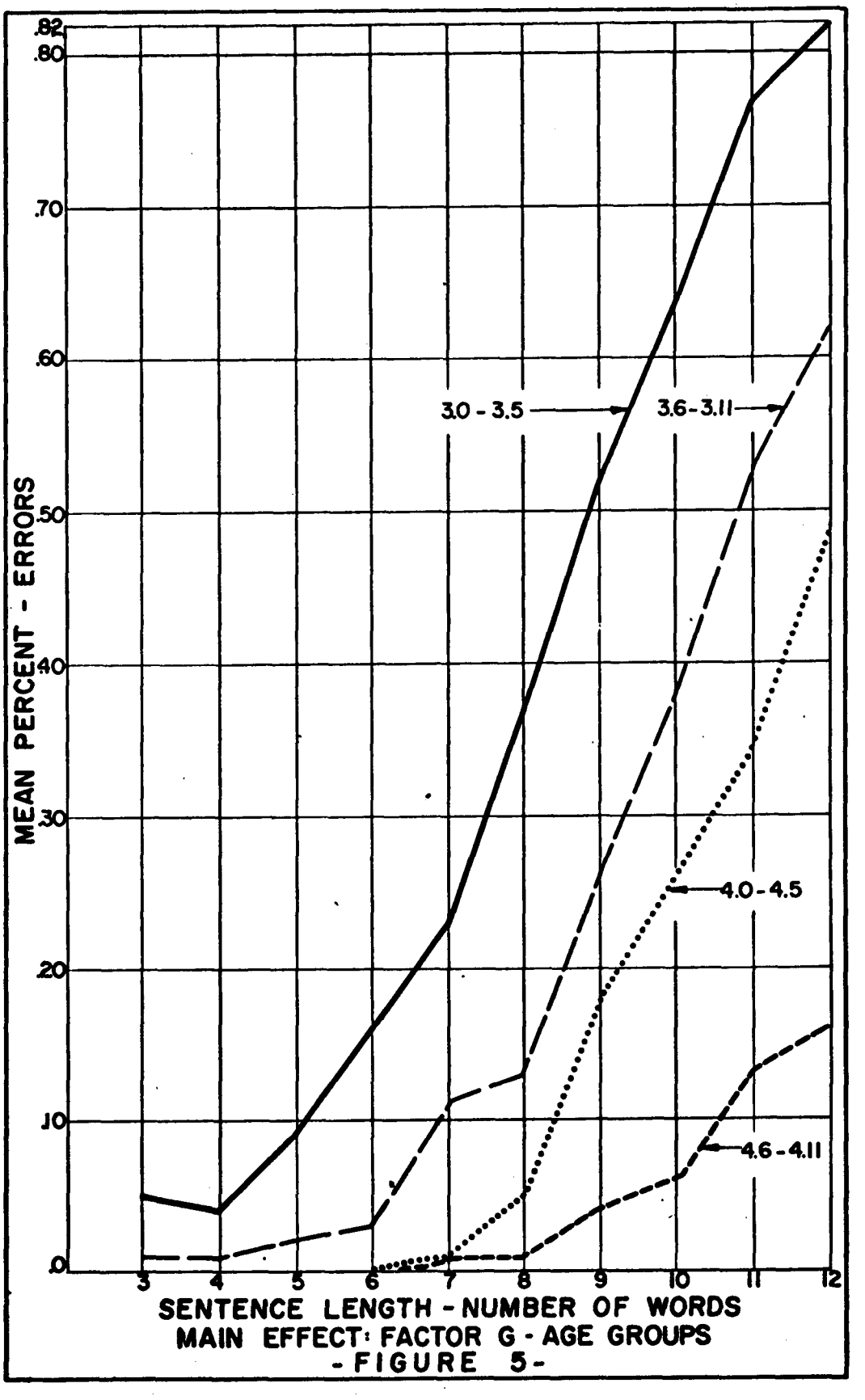
Age.--The effect of age (factor G) is significant at the .01 level for sentence lengths three and eight through twelve, and at the .05 level for lengths five, six, and seven. The effect of age is not significant for four word sentences. Figure 5, p.128, indicates a low percentage of errors for three, four and five word sentences with an increase in percent of errors from six to twelve words. As predicted, the percent of errors is highest for the youngest children (3.0 to 3.5 years) and lowest for the oldest children (4.6 to 4.11 years), with the 4.0 to 4.6 year olds achieving fewer errors than the 3.6 to 3.11 year olds.

Summary of Main Effects.--The results of the analysis of the main effects indicate first or second attempt was significant only for the longer sentences (seven through twelve). This effect appears to be due to the form of the verb in that more errors are made when the verb is irregular and in the simple past tense than when the verb form is regular and in the present tense. Sentence type was found to be significant at all sentence lengths but eleven words.



MAIN EFFECT: FACTOR X - SEX

- FIGURE 4 -



MAIN EFFECT: FACTOR G - AGE GROUPS

- FIGURE 5 -

Low error scores were found for sentences of all types for three to six words followed by a steady increase in errors as sentence length increased. The predicted order of difficulty of the sentence types was not found. Negative sentences were easiest to repeat, having the fewest number of errors. NPQ sentences were most difficult, as predicted, except on eleven and twelve word sentences where NPQ was among the three easiest sentence types. The predicted easiest sentence type, SAAD, ranged in difficulty from third easiest to second most difficult. The Q and P sentences generally ranked between second and fourth in ease of repetition. The NP, NQ, and PQ sentences ranged in difficulty from third easiest to most difficult. The overall effect of sentence type appeared to be largely dependent on the length of the sentence. The effects of subjects and sex were not statistically significant, indicating no major differences between individual children or between males and females. Age was an extremely important factor in that errors on sentences decreased as age of the child increased.

Interaction Effects

The results of the interactions will be presented as follows: those related to Factor A will be presented first, followed by those involving Factor T. The sentence type x age group interaction was the most statistically significant and most relevant to the present study and will be discussed in greater detail than any of the other interaction effects.

The two, three and four factor interactions involving factor A were generally not statistically significant with only a few significant interactions at varying sentence lengths. Interactions of first or second attempt with sex (AX), with sex, type and subjects (ATX, ASX, ATSX), and with age groups (ATG, ATXG) were not statistically significant at any sentence length. The interaction of attempt and sentence type was only significant (at .01 level) for nine word sentences but was insignificant at all other sentence lengths. The interaction of attempt and age groups was significant at the .01 level for lengths six and eleven. For lengths eight, nine and twelve this interaction was only significant at the .05 level. At all other lengths, the AG interaction was not statistically significant. The majority of the interactions of AS, ATS, ASG, AXG, and ASXG were not significant with the following exceptions. At the .05 level of confidence, AS was significant for four and nine word sentences, ATS for nine and ten word sentences, ASG for twelve word sentences and AXG for nine word sentences. At the .01 level, the ASXG interaction resulted in low but significant F ratios at nine and ten word sentences only. The overall effect of the interactions involving first or second attempt produced results which were not statistically significant with a slight tendency for low but significant F ratios for nine and ten word sentences. This particular result is not surprising in view of the fact that at or around nine words was often the cut-off point at which many children ceased to respond to

the test material. If they made an attempt at the first of the nine word sentences but ceased to respond after this, then there would be an expected difference between the A and B forms of the sentences of that length.

The interactions involving sentence type, particularly with subjects and age groups, were generally very significant. The type x subjects (TS) interaction was significant at the .01 level for all sentence lengths except for eleven word sentences (where it was not significant) and for five and nine word sentences, significant at only the .05 level. The type x age (TG) interaction was highly significant at all lengths except for eleven words (there not significant) and at seven words, significant only at the .05 level. The TSG and TSXG interactions were both significant at all sentence lengths except eleven words. TSX was significant at all lengths, except ten and eleven words, and only at the .05 level for twelve word sentences. TX and TXG interactions were generally not significant. No explanation can be offered for the lack of statistical significance for all factors at eleven word lengths.

The most significant effect which emerges from these results is the interaction of sentence type with age group. The main effects of sex and subjects were not statistically significant and remain generally non-significant in the above cited interactions. The interactions involving the Subject factor were significant but this is probably an additional effect of age rather than a separate effect of subject

ranking, particularly in view of the non-significance of S and the SG interaction. None of the interactions of SX, SG, XG was statistically significant, again supporting the view that age is the only significant subject variable.

Type X Groups Interaction.--Since the main effects of type and age group and the interactions of these factors were significant, the TG interaction was analyzed further. Figures 6 through 15 (pp.135-144) present the TG interactions for each sentence length. (The plotted $sigma_1$ and $sigma_2$ are approximate estimates of experimental error.)

From Figures 6 through 10 (pp. 135-139) (sentence lengths three through seven) it can be seen that very few errors were made by the oldest subjects. Table 1 (p. 133) presents numbers of completely correctly repeated sentences. It can be seen that for sentence lengths three through seven fifty percent or more of the sentences presented were repeated without error. As found from analysis of the main effects, errors on the TG interaction increase as sentence length increases and age of the subject decreases. Results similar to the main effect of factor T are also found on the TG interaction. The predicted order of difficulty of sentence types was not confirmed. Negative sentences were found to be generally easiest to imitate (having the least number of errors) and NPQ sentences were generally most difficult to repeat (having the greatest number of errors). This finding, however, was not consistent at every sentence

Table 1

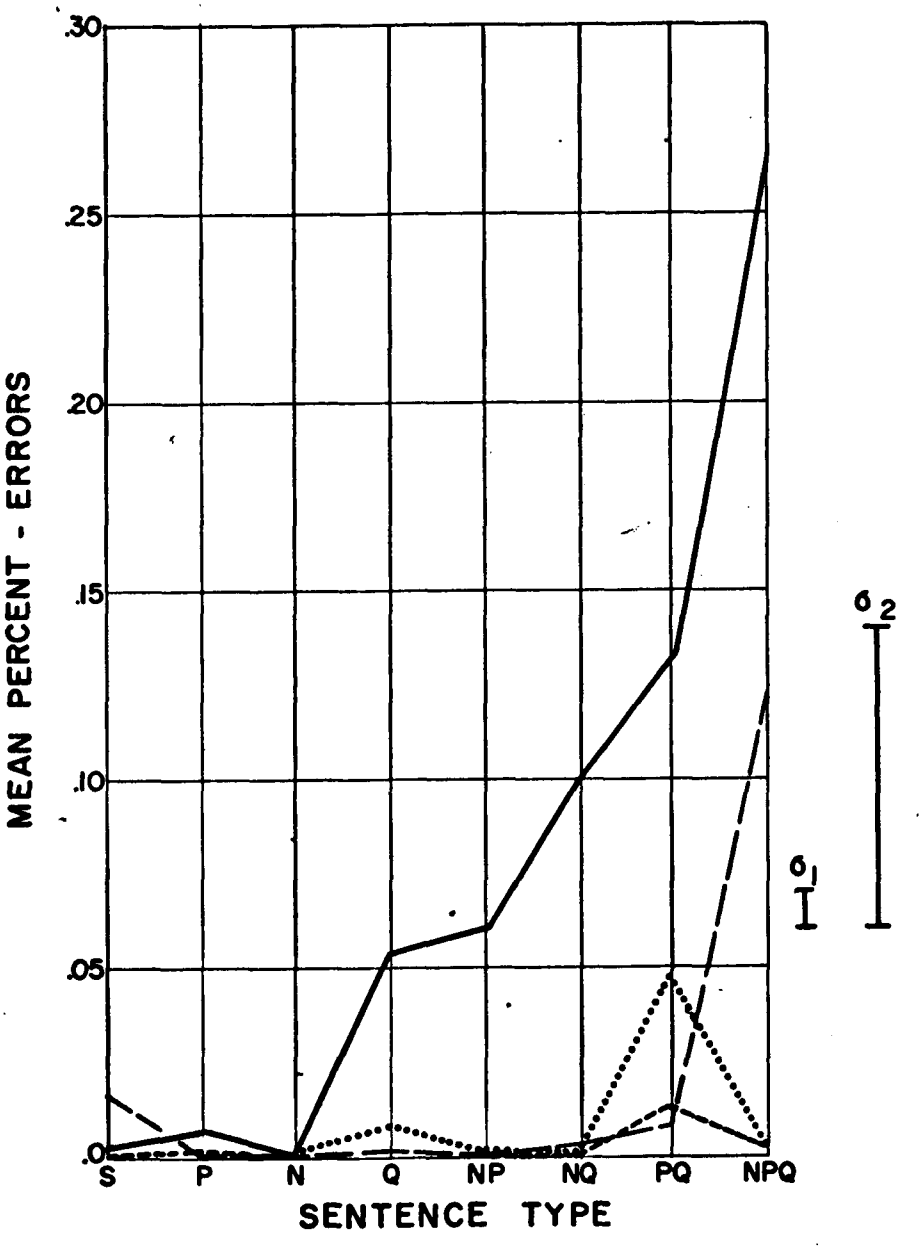
Number of Sentences Completely Correct for Each Sentence Length and Sentence Type for Each of the Four Age Groups

(N=20 possible correct sentences per cell)

	Sentence Type							
S length	S	P	N	Q	NP	NQ	PQ	NPQ
			Group I--3.0-3.5 (males + females)					
3	19	18	20	14	14	13	12	5
4	20	19	17	10	14	12	11	9
5	15	13	16	10	11	8	12	8
6	12	12	16	9	6	9	8	5
7	9	9	12	7	7	6	6	4
8	6	6	9	8	5	7	4	0
9	5	3	6	3	2	4	3	0
10	0	2	5	2	2	3	0	0
11	1	1	1	1	1	1	0	0
12	2	1	2	1	1	0	0	0
			Group II--3.6-3.11 (males + females)					
3	17	20	20	19	20	17	18	12
4	16	14	19	18	18	17	14	16
5	15	15	16	17	19	15	16	12
6	13	12	17	15	12	15	12	11
7	4	9	11	9	9	12	8	6
8	7	7	13	9	6	11	4	3
9	3	5	9	3	5	3	5	2
10	4	0	6	4	2	4	0	2
11	2	0	2	3	1	1	2	1
12	0	0	0	1	0	0	1	1
			Group III--4.0-4.5 (males + females)					
3	18	20	20	18	19	19	16	18
4	18	20	20	18	19	18	16	18
5	20	19	20	18	18	19	18	17
6	17	20	17	18	15	16	19	17
7	14	19	18	16	15	16	12	16
8	10	13	15	12	7	16	11	4
9	10	5	13	5	6	5	7	6
10	6	3	11	5	5	8	4	2
11	2	1	4	5	3	4	6	4
12	1	3	3	1	3	2	1	4

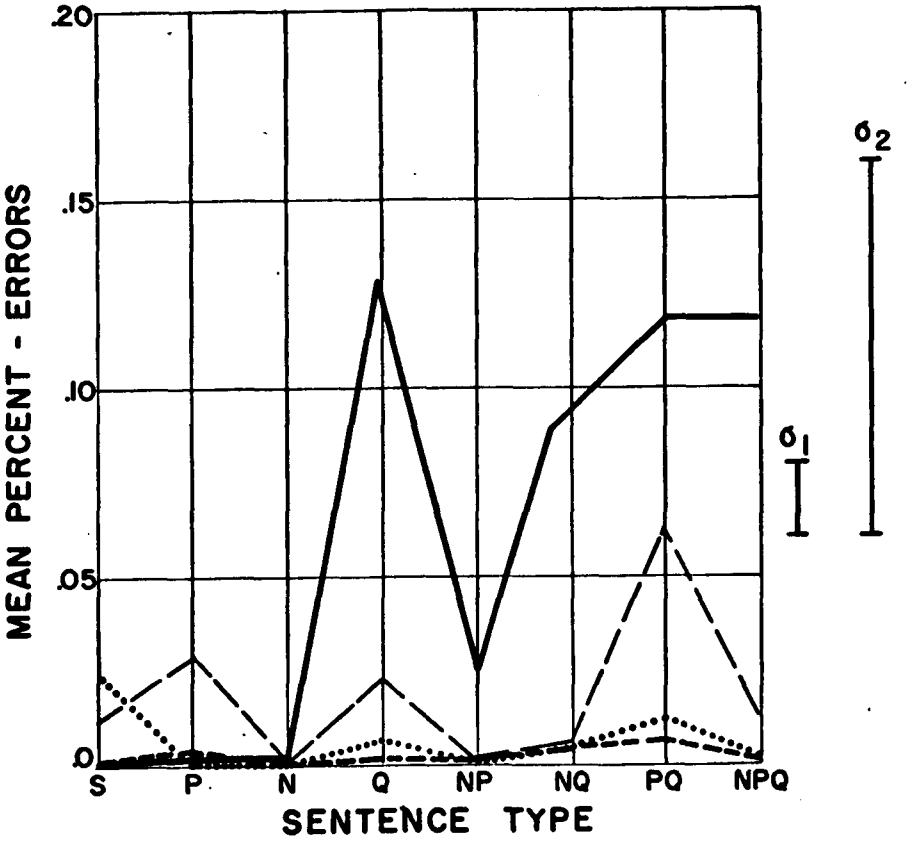
Table 1 (cont'd)

S length	S	P	N	Q	NP	NQ	PQ	NPQ
			Group IV--4.6-4.11 (males + females)					
3	20	19	20	19	20	20	18	19
4	19	19	20	19	19	18	18	18
5	20	15	20	20	19	18	18	19
6	18	19	19	18	18	17	16	17
7	15	16	17	17	17	19	17	16
8	16	17	18	17	14	15	17	15
9	16	10	17	16	11	15	10	8
10	12	9	14	13	8	16	8	9
11	4	5	7	9	4	7	5	6
12	2	6	5	4	4	3	6	6



SENTENCE TYPE x AGE GROUP INTERACTION FOR 3-WORD SENTENCES

-FIGURE 6-



KEY

3.0 - 3.5

3.6 - 3.11

4.0 - 4.5

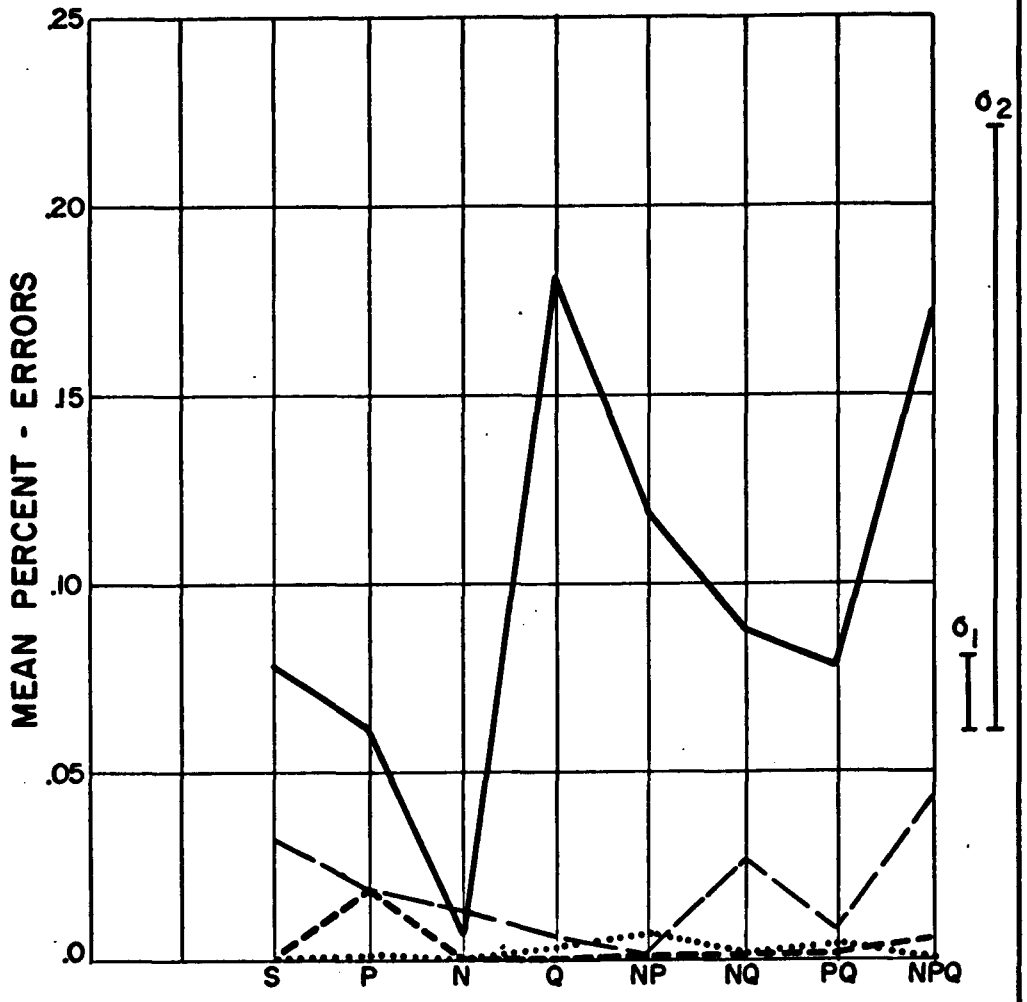
4.6 - 4.11

σ_1 = EXPERIMENTAL ERROR

σ_2 = ERROR DUE TO INTERSUBJECT VARIABILITY

SENTENCE TYPE x AGE GROUP INTERACTION FOR 4-WORD SENTENCES

- FIGURE 7 -



KEY

——— 3.0 - 3.5

— — — — 3.6 - 3.11

····· 4.0 - 4.5

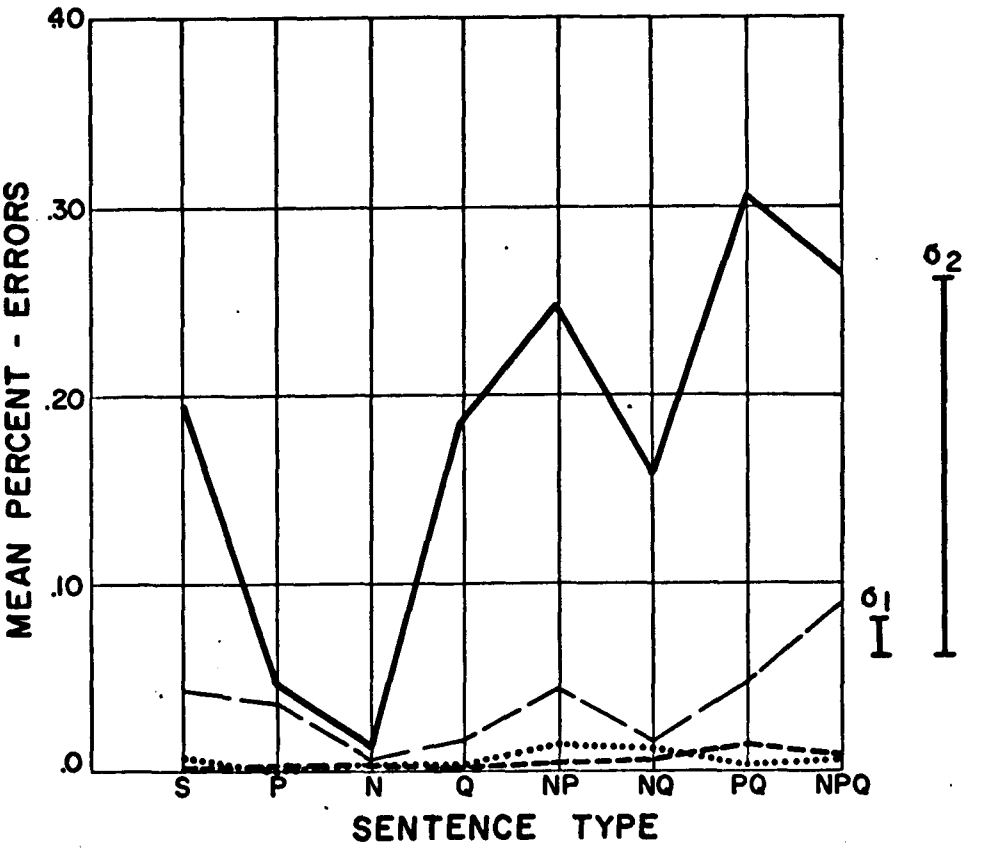
- - - - - - 4.6 - 4.11

σ_1 = EXPERIMENTAL ERROR

σ_2 = ERROR DUE TO INTERSUBJECT VARIABILITY

SENTENCE TYPE x AGE GROUP INTERACTION
FOR 5-WORD SENTENCES

- FIGURE 8 -



KEY

3.0 - 3.5

3.6 - 3.11

4.0 - 4.5

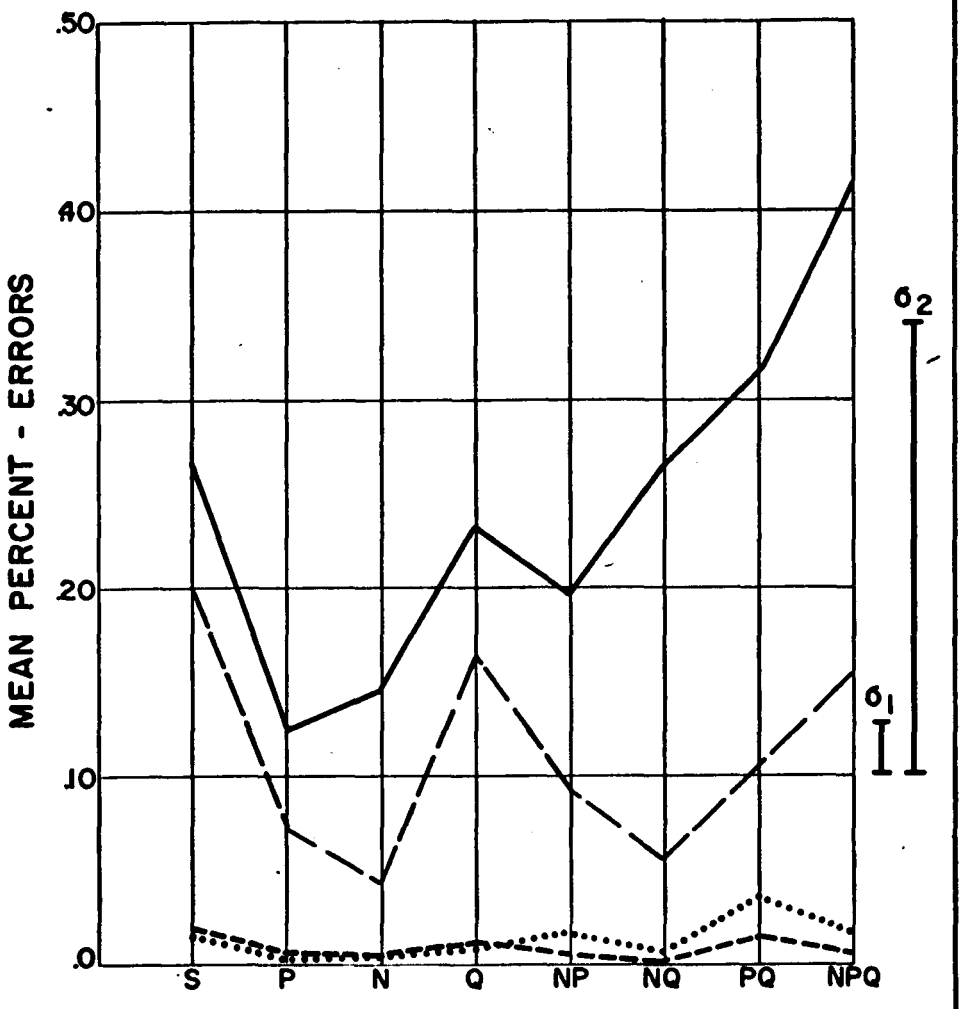
4.6 - 4.11

σ_1 = EXPERIMENTAL ERROR

σ_2 = ERROR DUE TO INTERSUBJECT VARIABILITY

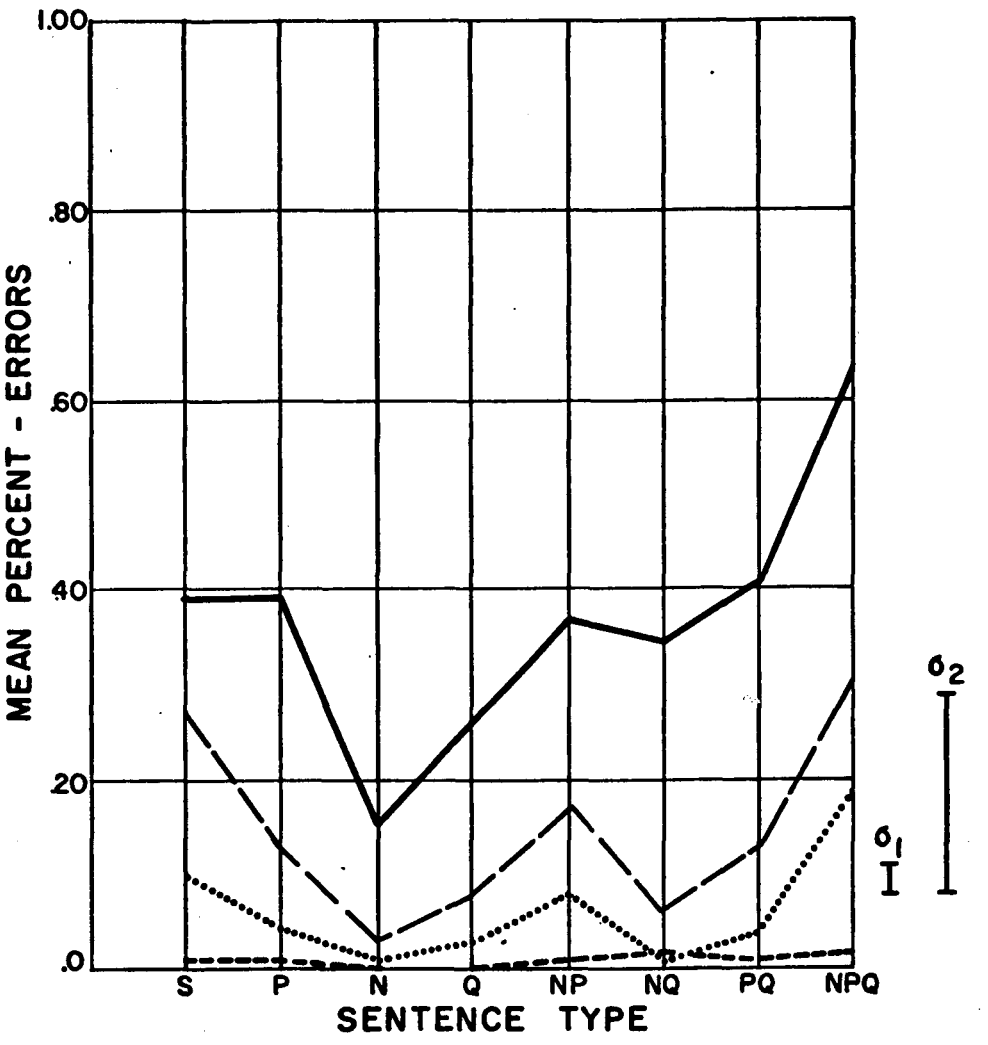
SENTENCE TYPE x AGE GROUP INTERACTION
FOR 6-WORD SENTENCES

-FIGURE 9-



SENTENCE TYPE x AGE GROUP INTERACTION
FOR 7-WORD SENTENCES

- FIGURE 10-



KEY

3.0 - 3.5

3.6 - 3.11

4.0 - 4.5

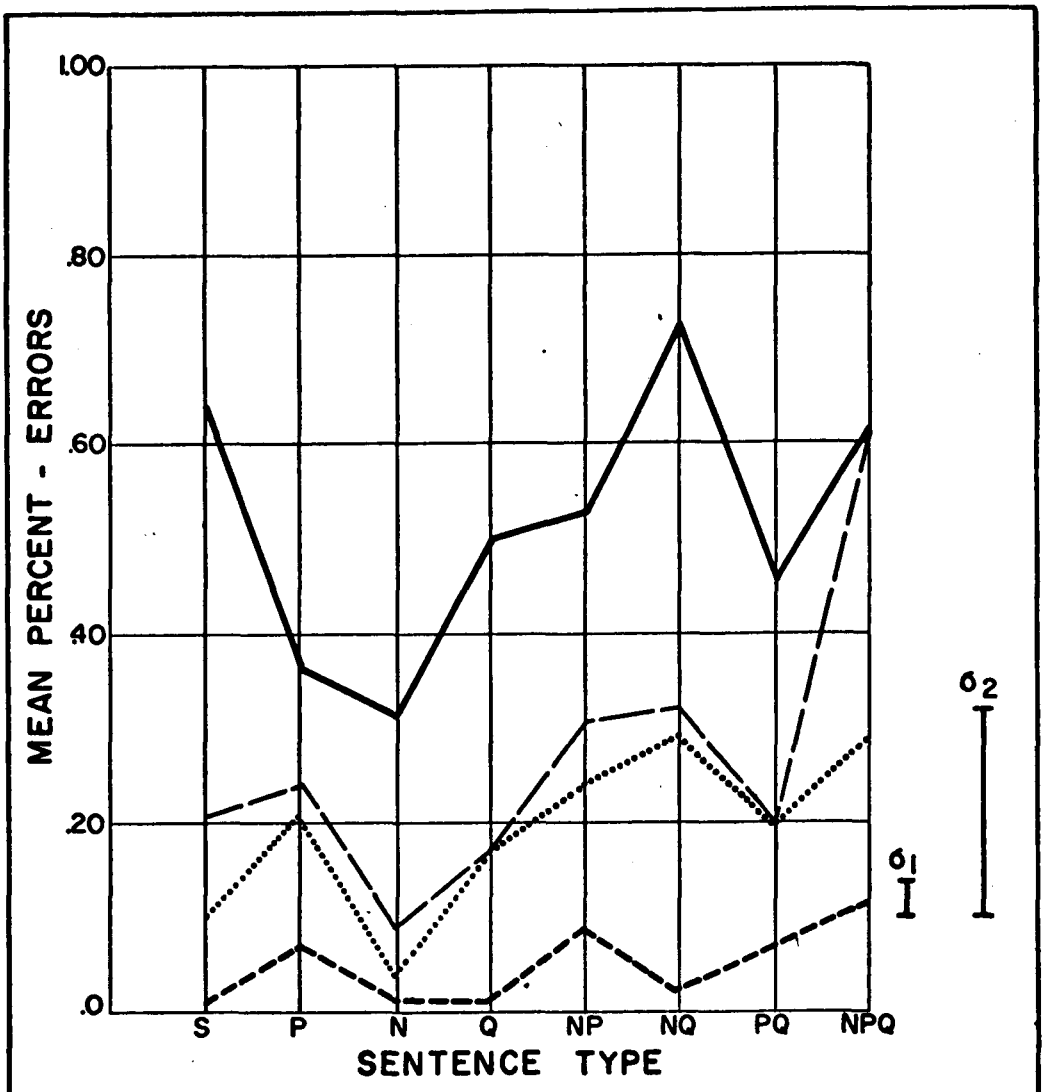
4.6 - 4.11

σ_1 = EXPERIMENTAL ERROR

σ_2 = ERROR DUE TO INTERSUBJECT VARIABILITY

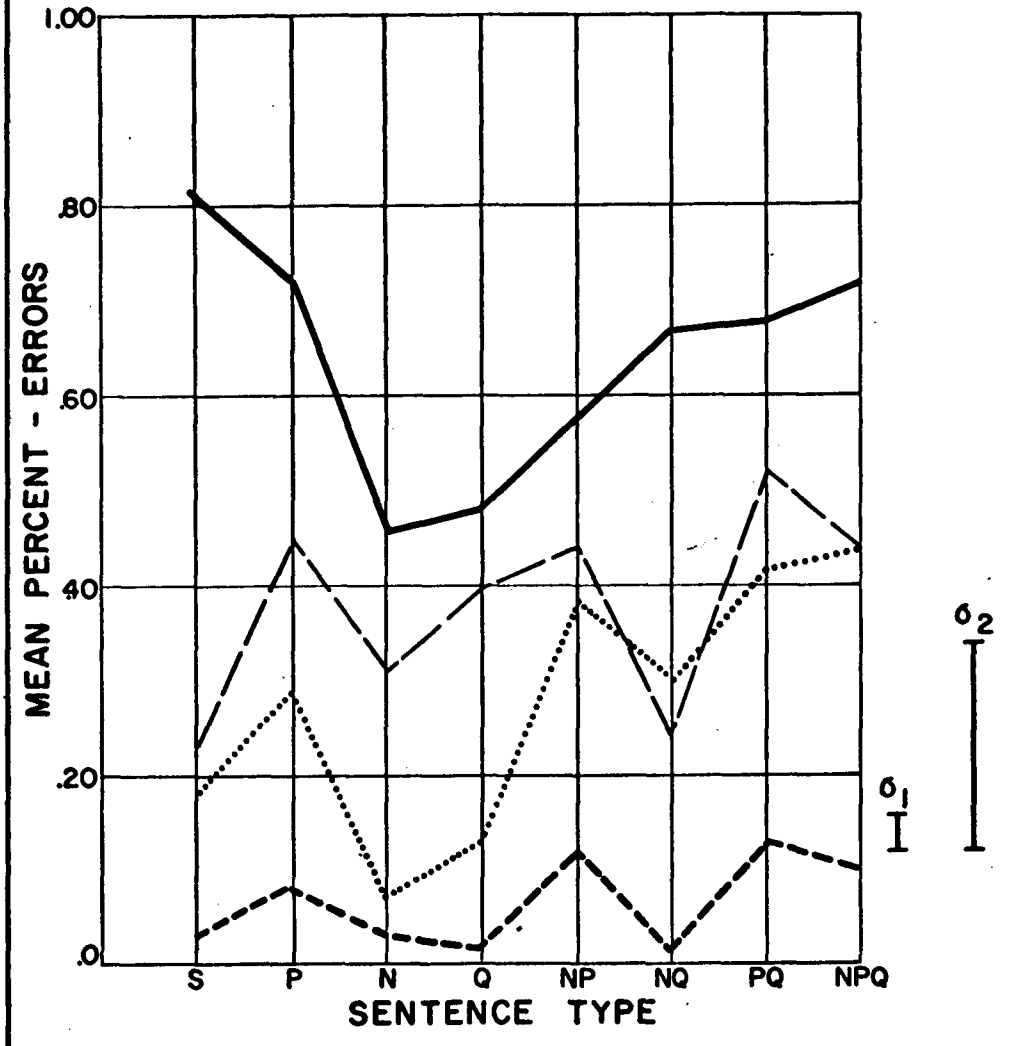
SENTENCE TYPE x AGE GROUP INTERACTION FOR 8-WORD SENTENCES

- FIGURE 11 -



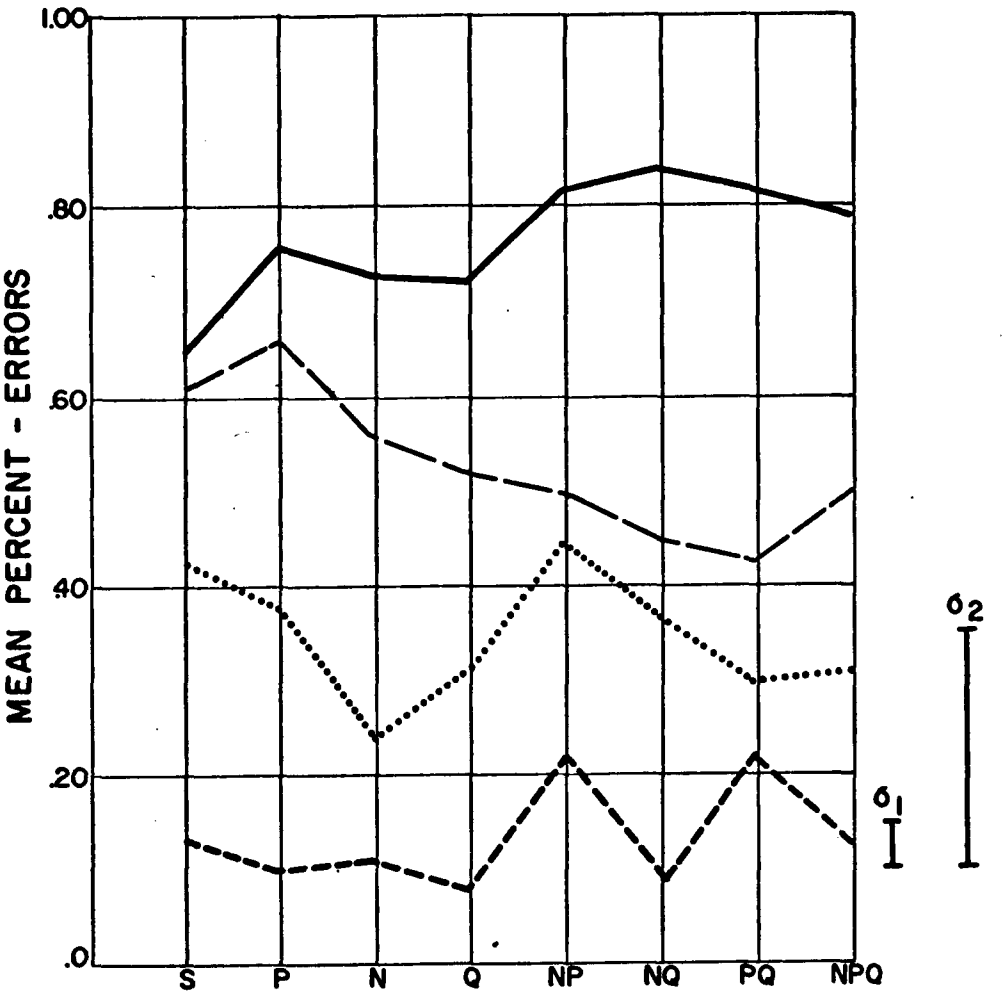
SENTENCE TYPE x AGE GROUP INTERACTION FOR 9-WORD SENTENCES

-FIGURE 12-



SENTENCE TYPE x AGE GROUP INTERACTION FOR 10-WORD SENTENCES

- FIGURE 13-



KEY

3.0 - 3.5

3.6 - 3.11

4.0 - 4.5

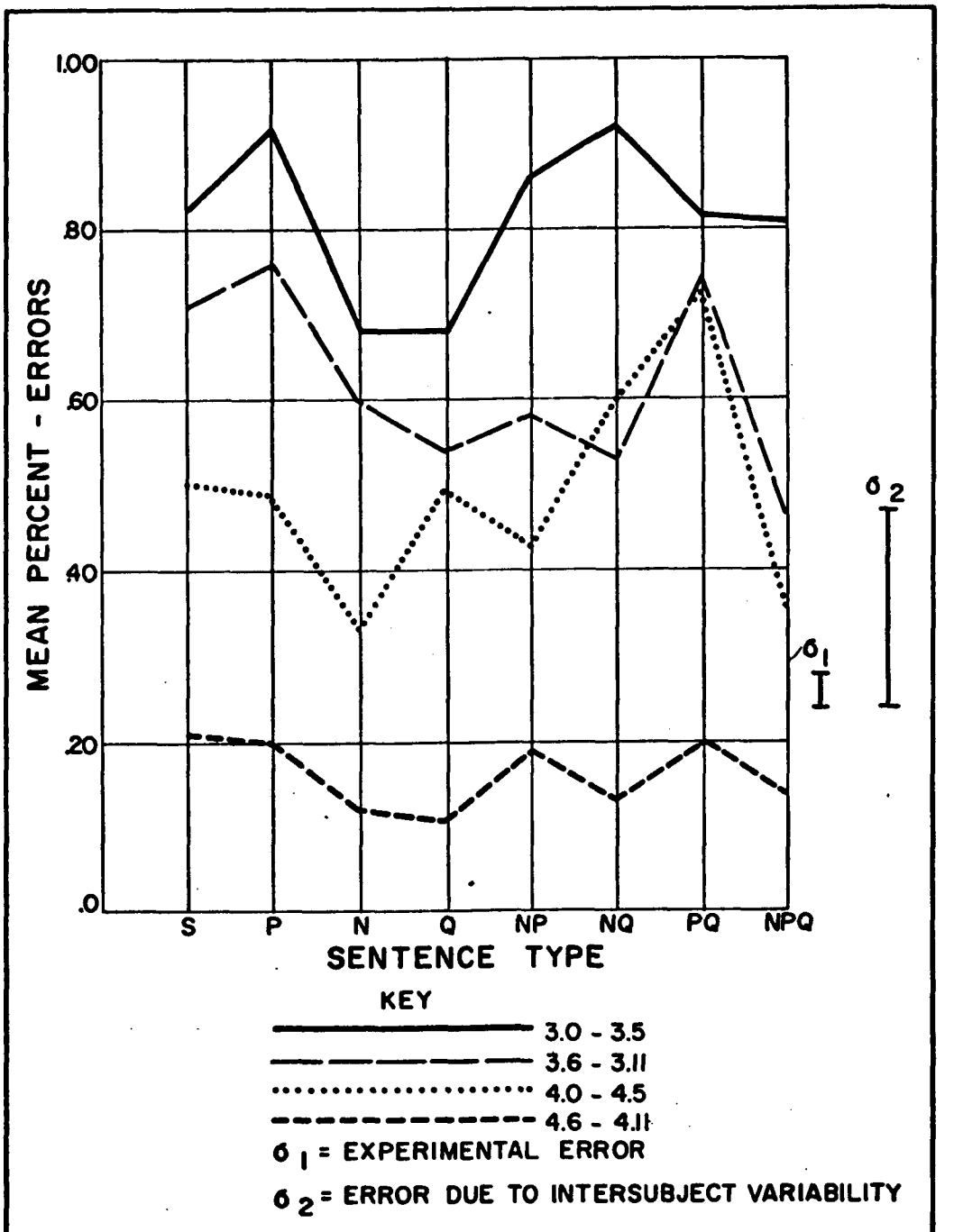
4.6 - 4.11

σ_1 = EXPERIMENTAL ERROR

σ_2 = ERROR DUE TO INTERSUBJECT VARIABILITY

SENTENCE TYPE x AGE GROUP INTERACTION
FOR 11-WORD SENTENCES

- FIGURE 14 -



SENTENCE TYPE x AGE GROUP INTERACTION FOR 12-WORD SENTENCES

- FIGURE 15 -

length or for each age group. Table 2 (p.146) presents the rank order of sentence types for each length for each of the four age groups. (The rank ordering is based on the TG interaction means with a rank of one for the sentence type with the lowest mean score and the rank of eight for the sentence having the highest mean error score.)

The overall results of the TG interaction show that for all age groups and across sentence lengths negative sentences are generally easiest to imitate and NPQ sentences are most difficult with the approximate order of increasing difficulty of sentence types represented as: N < Q < SAAD= P=NQ=NP < PQ < NPQ. It is noted that there is a different ranking for each length and each age group with the general exceptions of the easiest and most difficult positions as reported above. The order of difficulty is related to transformational complexity in that optional singular transformations are easier than double or triple transformations, with SAAD sentences falling somewhere in the middle range of difficulty, depending upon the particular age of the child and the sentence length. If the sentences are analyzed in terms of only three groups related to difficulty, then the SAAD and single optional transformational types P, N, Q rank among the easiest grammatical forms to imitate with the order within this group N≤Q<SAAD=P; the double-based transformational types rank next in difficulty with the approximate ranking within this group NQ=NP≤PQ; and the

Table 2

Rank Order of Sentence Types for Each Sentence Length and Age Group based on TG Interaction Mean Error Scores

S length-Age group*	Sentence Type S	P	N	Q	NP	NQ	PQ	NPQ
3- I	2	3	1	4	5	6	7	8
II	7	2	2	4	2	5	6	8
III	7	1.5	1.5	6	3.5	3.5	8	5
IV	2.5	6	2.5	6	2.5	2.5	8	6
4- I	1	2	3	6	4	5	6	6
II	4	7	1	6	2	3	8	5
III	8	1.5	1.5	6	3	5	7	4
IV	2.5	4.5	1	2.5	4.5	7	8	6
5- I	3.5	2	1	8	6	5	3.5	7
II	7	5	4	2	1	6	3	8
III	1.5	3	1.5	6	8	5	4	7
IV	2	8	2	2	5	6	7	4
6- I	5	2	1	4	6	3	8	7
II	5	4	1	3	6	2	7	8
III	6	1	4	3	8	7	2	5
IV	3	1.5	1.5	4	5	6	8	7
7- I	5	2	1	4	3	6	7	8
II	8	3	1	7	4	2	5	6
III	5	1	2	3.5	6	3.5	8	7
IV	8	4	2	6	3	1	7	5
8- I	5	6	1	2	4	3	7	8
II	7	5	1	3	6	2	4	8
III	7	4	2	3	6	1	5	8
IV	4	3	1	2	6	7.5	5	7.5
9- I	7	2	1	4	5	8	3	6
II	4	5	1	2	6	7	3	8
III	2	5	1	3	6	7	4	8
IV	4	2	1	3	7	5	6	8
10- I	8	6	1	2	3	4	5	7
II	1	7	3	4	6	2	8	5
III	3	4	1	2	7	5	6	8
IV	3	5	4	2	7	1	8	6

* Age Groups: I=3.0-3.5 years; II=3.6-3.11 years; III=4.0-4.5 years; IV=4.6-4.11 years.

Table 2 (cont'd)

S length- Age group	S	P	N	Q	NP	NQ	PQ	NPQ
11- I	1	4	3	2	6	8	7	5
II	7	8	6	5	3	2	1	4
III	7	6	1	4	8	5	2	3
IV	6	3	4	1	8	2	7	5
12- I	4	7	2	1	6	8	5	3
II	6	8	5	3	4	2	7	1
III	6	4	1	5	3	8	7	2
IV	8	6	2	1	5	3	7	4

triple-based transformational type NPQ rank as most difficult. It appears that, although not completely satisfactory, transformational history does account for some of the observed order of difficulty of sentence types. However, since each sentence type varies a great deal in terms of its rank order of difficulty, it appears that sentence length is also an important and consistent determinant of difficulty of imitation.

The TG interaction for three word sentences indicates that very few errors occur for all age groups, with the youngest subjects having the most errors and the older three groups making almost no errors. The types SAAD, N and P for all age groups are approximately the same, having the fewest number of errors. Most errors are made on PQ and NPQ sentences for all subjects. For the youngest children, the predicted order of difficulty is seen, with the exception that P sentences are slightly more difficult than either SAAD or N forms.

For the four word sentences, similar results are seen in terms of generally correct responses for the older groups and the approximate predicted order of difficulty maintained with the exception of Q sentences, which were as difficult for the 3.0 to 3.5 year olds as the NPQ sentences. For the 3.6 to 3.11 year olds, PQ shows the greatest mean percent errors with few errors on all other sentence types.

On five word sentences, the three older groups continue to make relatively few errors, and a new hierarchy of

difficulty of sentence types appears for the youngest subjects. The observed order of difficulty for five word sentences (from easiest to hardest) is N < P < SAAD=PQ < NQ < NP < NPQ < Q, although NPQ and Q are only different by one percentage point. This would indicate that two of the three single-based transformations are easiest, that SAAD and double-based transformations are next in difficulty and that triple-based NPQ sentences and single transformed Q are most difficult to imitate.

Six word sentences continue to maintain the very low number of errors for the older groups with the errors increasing for the older three year olds. For the 3.6 to 3.11 group, relatively similar mean percent errors are seen for all sentence types with a slight increase in number of errors for NPQ sentences. The 3.0 to 3.5 year olds continue to make the greatest number of errors, and the order of difficulty for the six word sentences based on the TG interaction scores is now N < P < NQ < Q < SAAD < NP < NPQ < PQ. Negative and passive sentences are still the easiest; Q sentences have become easier; and SAAD sentences have become more difficult than they were for five word sentences. The added difficulty of SAAD sentences at this sentence length may be related to the first occurrence of an adjective in the sentence. There is also an adjective in NQ and Q sentences, all of which are about equal in percent error scores. Again, three of the four sentence types with two or three optional transformations

in their derivation are found to be the more difficult types to imitate.

On seven word sentences there is a sudden increase in errors for Group II. The four year olds maintain a low level of errors with no great differences seen for any sentence type. Both three year old groups show orders of difficulty on sentence types similar to those previously indicated. For the youngest children (3.0-3.5 years) the observed order of sentence difficulty is P < N < NP < Q < SAAD=NQ < PQ < NPQ, whereas for Group II (3.6-3.11 years), the observed order is N < NQ < P < NP < PQ < NPQ < Q < SAAD. For seven word sentences P, N, and NP are among the easiest to imitate, and Q and SAAD have become more difficult. The double and triple-based transformations are still most difficult for Group I but fall in the middle range of difficulty for Group II. For Group II, the N and P and combinations of these transformations are easiest; whereas Q and SAAD are most difficult and the predicted order of difficulty is generally not maintained.

On eight word sentences, Group III errors start to increase, with Group IV continuing to make few errors on all sentence types. The order of observed difficulty for Group I is N < Q < NQ < NP < SAAD < P < PQ < NPQ; for Group II it is N < NQ < Q < PQ < P < NP < SAAD < NPQ; and for Group III it is NQ < N < Q < P < PQ < NP < SAAD < NPQ. A number of similarities between ages are seen here. The three easiest sentence types for all three age groups are N, Q and NQ. For Groups II and III P,

PQ, and NP are among the second most difficult sentences and SAAD and NPQ are most difficult. For the youngest subjects the SAAD and all sentences involving at least one passive transformation are most difficult.

On nine word sentences there is an increase in errors for the oldest group and a hierarchy of sentence difficulty emerged for them. The hierarchy of sentence difficulty for the four age groups is as follows:

Group I - N < P < PQ < Q < NP < NPQ < SAAD < NQ;

Group II - N < Q < PQ < SAAD < P < NP < NQ < NPQ;

Group III - N < SAAD < Q < PQ < P < NP < NQ < NPQ;

Group IV - N < P < Q < SAAD < NQ < PQ < NP < NPQ.

Certain similarities occur again. For all ages, Negative sentences are easiest to imitate; and for the three oldest groups NPQ sentences are most difficult. SAAD sentences range in order of difficulty from second easiest to second most difficult. The easier sentences tend to be those with only one optional transformation in their derivation. The most difficult forms are those with two or more optional transformations with the exception of PQ, which is among the easiest for three of the four age groups. The oldest children's errors yield a hierarchy of difficulty closest to the predicted order of sentence difficulty. For these children, only the SAAD sentence does not follow the predicted pattern.

For sentence lengths ten, eleven, and twelve there is a marked increase in number of errors for each age group and

greater differences between age groups in terms of percentage of errors, with errors continuing to increase as a function of both increase in age and increase in sentence length. The following are the hierarchies of difficulty for sentence types for each age group for the three sentence lengths ten, eleven, and twelve:

For ten word sentences:

Group I - N < Q < NP < NQ < PQ < P < NPQ < SAAD

Group II - SAAD < NQ < N < Q < NPQ < NP < P < PQ

Group III - N < Q < SAAD < P < NQ < PQ < NP < NPQ

Group IV - NQ < Q < SAAD < N < P < NPQ < NP < PQ

For eleven word sentences:

Group I - SAAD < Q < N < P < NPQ < NP < PQ < NQ

Group II - PQ < NQ < NP < NPQ < Q < N < SAAD < P

Group III - N < PQ < NPQ < Q < NQ < P < SAAD < NP

Group IV - Q < NQ < P < N < NPQ < SAAD < PQ < NP

For twelve word sentences:

Group I - Q < N < NPQ < SAAD < PQ < NP < P < NQ

Group II - NPQ < NQ < Q < NP < N < SAAD < PQ < P

Group III - N < NPQ < NP < P < Q < SAAD < PQ < NQ

Group IV - Q < N < NQ < NPQ < NP < P < PQ < SAAD.

Rather different hierarchies are seen for these three sentence lengths and for the different age groups. On ten word sentences for all age groups, on eleven word sentences for Group I, and on twelve word sentences for Groups I and IV, Q and N sentences, and in some cases SAAD sentences, are among the easiest with the double and triple-based

transformational types either intermediate or most difficult. For Group II, however, on eleven and twelve word sentences, the order is almost completely reversed, with the double and triple-based transformations among the easiest and the SAAD and single-based transformation sentences the more difficult.

The overall effect of transformational complexity, as seen in the TG interaction and the results in general, does not completely confirm the predicted order of difficulty of sentence imitation although transformational history is shown to be an important factor in sentence imitation in a more general way. The effect of transformational history is not consistent over the different age levels or sentence lengths. However, as indicated above, there is a general tendency for N and Q sentences to be among the easiest forms to imitate and for NPQ sentences to be the most difficult. There is also a tendency for the double-based transformations to be more difficult than the single-based forms, confirming part of the hypothesized relationships among sentences of varying complexity. However, the SAAD sentence, hypothesized to be the simplest grammatical type, occupied almost every position from easiest to most difficult, depending upon the particular age group and sentence length. There were also a number of instances in which a particular double-based transformation was found to be easier than its single-based counterparts, such as instances where PQ sentences were easier than either P or Q forms on which the PQ form is theoretically based.

Analysis of Errors

An initial tabulation of errors included four large categories of errors: additions, deletions, substitutions, and permutations. These were further sub-divided into errors occurring on the different parts of speech found in each sentence. When this data was examined, it was found that deletions and substitutions accounted for the majority of total errors. Comparatively few words were permuted. Additions were mainly in the form of an utterance of extraneous words bearing no relationship to the sentence presented for imitation. This original error analysis, however, did not tabulate as errors words in sentences to which the child did not respond. This error analysis also included too many categories to describe in a meaningful way. The error analysis was therefore modified to permit presentation of trends shown by the children.

Errors of deletion and substitution were combined to give an estimate of the total number of errors. Errors of permutation were analyzed as a separate group. Errors of addition were not treated at all in the specific analysis of errors. Additions which changed the grammatical structure of the sentence, such as addition of a negative morpheme to a form of the word "do" in the question sub-test, were tabulated and the error counted in the percent error score for that sentence. However, very few of this type of addition error occurred. Most additions to the target sentences were

in the form of extraneous and unrelated words, such as "I want to go back to my class." Since so few errors of addition which changed the basic grammatical structure of the sentence were made, no further analysis of addition errors was necessary. The test used in this study was not specifically designed to control or balance the distribution of traditional parts of speech in each sentence. There was, therefore, an unequal distribution across sentence lengths and types of particular word classes. Since this condition existed, total numbers of words for each sub-test were calculated, summing the number of each word type for all sentence lengths. Additional rationale for this summation was that most errors occurred on longer sentences and that total scores for each sub-test (for all lengths on that sub-test) might present more interesting and meaningful results.

The analysis of specific error types was achieved by calculating the total number of each type of words on a particular sub-test and then grouping the word-type totals into three large categories. For purposes of the present study the following grouping of word categories was established. Articles, prepositions (including the word "by" used to form passive sentences) were called "Y" words. This category corresponds to the traditional function word class. Words traditionally classed as content words, including nouns, pronouns, verbs, and adjectives were called "X" words. A third category called "Z" words consisted of the words

"isn't/wasn't," "didn't/doesn't," and "did/does." This third category was divised so that analysis of the presence of these particular words, used to form the more complex sentence types, could be analyzed separately and could reveal specific difficulties. Each sub-test contains a total of 150 words. This was multiplied by ten to give a total number of 1500 words per sub-test presented to the ten children in each of the four age groups (five children of each sex). The total number of 1500 presented words per sub-test was divided into the numbers of words in each of the three categories and used as the target number of correct words of each type for each sub-test. The total target words for each category for each sub-test appear in Table 3, p. 157. Actual errors made by the children, plus the words in sentences to which the child did not respond, were summed for each sub-test and this total translated into a percentage of errors out of the total number of words available for each of the three categories. Table 4, p.158, presents the actual number of errors for each of the three categories of words, as well as the percentage of error for each sentence type. These results are also presented in Figures 16 and 17, pp. 159 and 160.

The results of the error analysis again show the decrease in numbers of errors made with increase in age. In general, most errors are made on "Y" words, with the "Z" category errors showing similar percent error rates to the

Table 3

Total Number of Words for Each Part of Speech and for Each of Three Classes of "X," "Y" and "Z" Word Categories. (Totals are based on target words for 10 subjects--five males and five females in each of the four age groups. Total number of words per sentence type is 1500.)

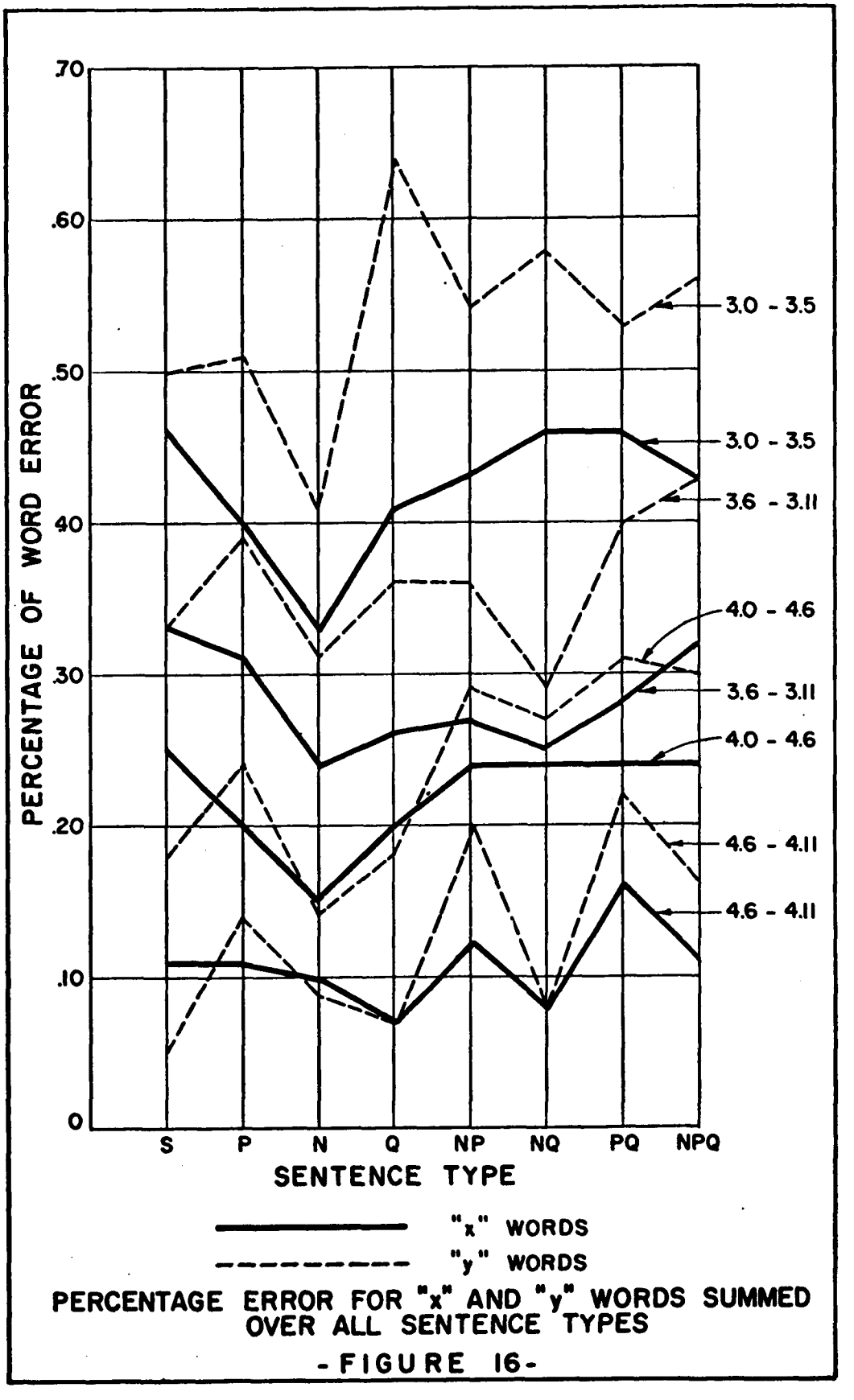
Sentence Type	"X" WORDS N/Pn	V	Adj.	"Y" WORDS Art.	Prep.	By	"Z" WORDS
S	500	200	280	420	100	--	--
Total		980			520		0
P	460	400	60	320	100	160	--
Total		920			580		0
N	480	200	150	370	100	--	200
Total		830			470		200
Q	480	200	150	370	100	--	200
Total		830			470		200
NP	460	200	60	320	100	160	200
Total		720			580		200
NQ	480	200	170	350	100	--	200
Total		850			450		200
PQ	460	400	60	320	100	160	--
Total		920			580		0
NPQ	460	200	60	320	100	160	200
Total		720			580		200

Table 4

Total Errors and Percent Errors on "X," "Y" and "Z" Word Categories as a Function of Sentence Type Summed Over all Sentence Lengths for Each of the Four Age Groups

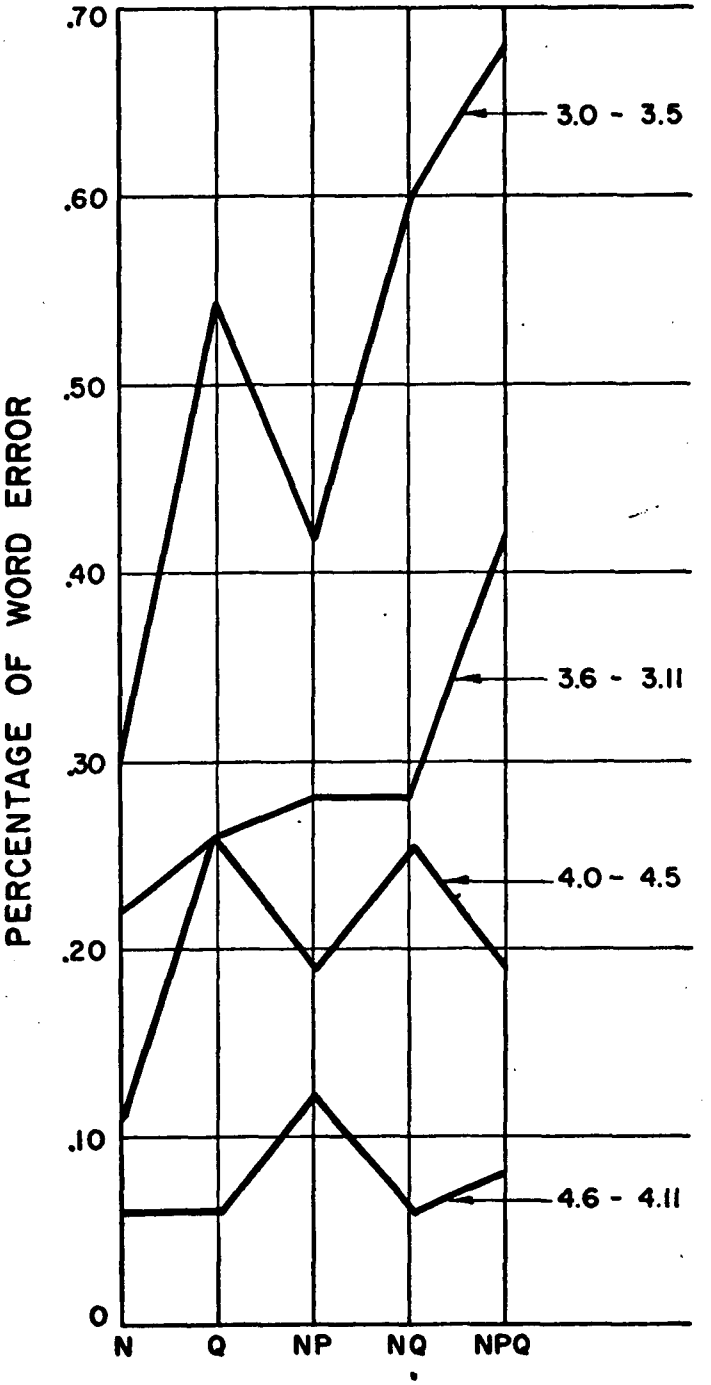
Age Group-Error Type	S	P	N	Q	NP	NQ	PQ	NPQ
I-"X"	449*	368	275	336	309	410	425	348
	.46**	.40	.33	.41	.43	.46	.46	.43
"Y"	259	295	189	302	316	261	310	323
	.50	.51	.41	.64	.54	.58	.53	.56
"Z"	0	0	60	108	84	119	0	136
	-	-	.30	.54	.42	.60	-	.68
II-"X"	328	283	201	215	194	210	261	233
	.33	.31	.24	.26	.27	.25	.28	.32
"Y"	173	229	147	170	210	132	231	247
	.33	.39	.31	.36	.36	.29	.40	.43
"Z"	0	0	44	52	55	56	0	83
	-	-	.22	.26	.28	.28	-	.42
III-"X"	249	180	121	163	171	201	224	175
	.25	.20	.15	.20	.24	.24	.24	.24
"Y"	91	141	64	86	167	122	177	172
	.18	.24	.14	.18	.29	.27	.31	.30
"Z"	0	0	21	52	38	49	0	37
	-	-	.11	.26	.19	.25	-	.19
IV-"X"	112	97	81	61	83	67	150	78
	.11	.11	.10	.07	.12	.08	.16	.11
"Y"	30	79	41	31	117	35	126	92
	.05	.14	.09	.07	.20	.08	.22	.16
"Z"	0	0	12	12	23	12	0	16
	-	-	.06	.06	.12	.06	-	.08

* Total number of errors.
** Percent error out of the total possible words of each word type.



PERCENTAGE ERROR FOR "x" AND "y" WORDS SUMMED OVER ALL SENTENCE TYPES

-FIGURE 16-



PERCENTAGE ERROR FOR "z" WORDS
SUMMED OVER ALL SENTENCE TYPES

- FIGURE 17-

"X" word category. Errors on articles comprised the greatest number of "Y" word errors. Errors on adjectives made up the greatest number of "X" word errors. The differences between errors on "X" and "Y" words are greatest for the three year olds. Similar error rates are seen on "X" and "Y" word categories for the four year olds. Error rates based on all three categories differ for the four age groups and for different sentence types.

Based on the number of errors on "Y" words, the hierarchy of observed difficulty was as follows for the four age groups:

Group I - $N < SAAD < P < PQ < NP < NPQ < NQ < Q$

Group II - $NQ < N < SAAD < Q=NP < P < PQ < NPQ$

Group III - $N < SAAD=Q < P < NQ < NP < NPQ < PQ$

Group IV - $SAAD < Q < NQ < N < P < NPQ < NP < PQ$.

The predicted order of difficulty based on the total number of "Y" words in the target sentences on each sub-test would be $NQ < Q=N < SAAD < P=NP=PQ=NPQ$. The number of errors on "Y" words again shows a tendency for transformational history to explain the errors recorded since SAAD and single-based transformations tend to have fewer errors. More errors occur on "Y" words which comprises the smaller amount of the total words on each sub-test. Those sentence types with the least number of "Y" words do tend to be easier to imitate than those with greater numbers of "Y" words. The hierarchy of predicted difficulty based on the number of

total "Y" words in each sentence type fairly well predicts the observed order of difficulty.

The predicted order of sentence difficulty based on the number of "X" words for each sub-test would be NP=NPQ < N=Q < NQ < P=PQ < SAAD, from those sentences with the fewest number of "X" words to the sentences with the most. The observed order of sentence difficulty based on errors on "X" words is as follows:

Group I - N < P < Q < NP=NPQ < SAAD=NQ=PQ

Group II - N < NQ < Q < NP < PQ < P < NPQ < SAAD

Group III - N < P=Q < NP=NQ=PQ=NPQ < SAAD

Group IV - Q < NQ < N < SAAD=P=NPQ < NP < PQ.

In no case are the sentences with the fewest "X" words easiest to imitate; but in three of the four age groups SAAD sentences are most difficult or among the most difficult to imitate. This indicates that sentences with a larger number of "X" words do appear to make imitation more difficult but that the transformational complexity of the sentence is also an important factor. It is interesting to note that negative and question forms, which in all analyses tended to be among the easiest sentence types to imitate, have among the lowest total number of both "X" and "Y" words. The fact that both of these sentence types have an additional word from the "Z" category does not appear to increase the difficulty of imitation.

The percentage of errors for the "Z" category could only be computed for five of the sentence types; SAAD, P and

PQ sentences have no words in this category. For each of the five sentence types, equal difficulty of these sub-tests is predicted, since a total of 200 words is available for each sentence type. The observed order of difficulty for the four age groups based on errors on the "Z" category is:

Group I - $N < NP < Q < NQ < NPQ$

Group II - $N < Q < NP=NQ < NPQ$

Group III - $N < NP=NPQ < NQ < Q$

Group IV - $N=Q=NQ < NPQ < NP$.

These results again confirm the ease of negative sentences for imitation. There appears to be unequal distribution in terms of the ease of actual word repetition in this category. The words "doesn't/didn't" occur in N and NQ sentences; "does/did" occurs in Q sentences; and "isn't/wasn't" occurs in NP and NPQ sentences. It would seem that "doesn't/didn't" is handled best and "isn't/wasn't" is handled most poorly, but this effect is not consistent for all age groups. It is also surprising that slightly fewer errors are made on the contraction of "not" with "did" than on the occurrence of "did" alone (which would seem to be the easier form).

The analysis of the number of permuted words shows very low error rates for the entire population. If one assumes that permutations could occur on all 1500 words on a particular sub-test (for ten subjects), the results of this analysis confirm the very few permutation errors made. The largest number of permuted words occurred for the

youngest children (Group I) on NPQ sentences but totaled only 55 permuted words. This result indicates that, in general, these children did not tend to rearrange sentence word order. Table 5, p.165 presents the figures on permutations, including the actual number of words permuted, and the percentage of error out of the total 1500 words that these errors constitute. For the three younger groups, the greatest number of permutations occur on PQ and NPQ sentences. Negative sentences still maintain the low error rate on this measure. There is also a slightly higher rate of permutations for double-based transformations, although this tendency is less in evidence for the oldest children who permute more words in SAAD, P, and NPQ sentences than in the double-based transformation sentences. These results do indicate that more permutation errors occur on sentence forms in which the transformational history consists of two or more transformations, one of which involves a permutation of word order to derive its surface structure.

Summary

All of the results presented above indicate that sentence length is the most important predictor of ease of imitation. Neither transformational complexity nor type of word category is completely successful in predicting the findings. In terms of transformational complexity, sentences with the single-based, negative transformation are generally the easiest to repeat, having the fewest numbers

Table 5

Number of Permuted Words and Percent Permutation Errors (from a total of 1500 words per subtest) as a Function of Sentence Type Summed Over all Sentence Lengths for Each of the Four Age Groups

	Sentence Type							
Age Group	S	P	N	Q	NP	NQ	PQ	NPQ
I	10*	4	7	24	12	13	37	55
(3.0-3.5)	.007**	.003	.005	.016	.008	.009	.024	.036
II	27	21	13	10	33	14	44	41
(3.6-3.11)	.018	.014	.009	.007	.022	.009	.029	.027
III	14	27	9	18	33	10	36	38
(4.0-4.6)	.009	.027	.006	.012	.022	.007	.024	.025
IV	17	22	9	11	6	14	10	22
(4.6-4.11)	.011	.014	.006	.007	.004	.009	.007	.014

* Total permuted words.
** Percent permutation errors.

of errors on all analyses. The sentences with the triple-based negative-passive-question transformation are generally the most difficult to imitate, having the greatest numbers of errors. The middle range of difficulty is occupied by sentences having either one or two optional transformations in their histories with the tendency for those sentences with only one optional transformation to be easier. The difficulty with SAAD sentences, ranging in difficulty from easiest to most difficult but tending to fall somewhere in the middle range, may be related to the greater number of "X" words differentially distributed according to sentence length. In terms of word categories, the results indicate greater errors on "Y" words, with lower and similar percent error rates found both for "X" and "Z" words. The most consistent effect found in this study is that of sentence length, showing a steady increase in errors with increase in length for both sexes. No significant sex differences were found. The results also show a consistent effect of decrease in overall errors with increase in age.

The results also suggest that sentence processing strategies need to be employed for correct imitation on sentences of lengths seven words and longer, since generally low error rates on all sentence types are seen for sentences shorter than seven words. In view of the different error scores achieved on sentences of the same length but of different grammatical types, sentence length alone cannot

account for the results. Sentence length increases the difficulty of repeating sentences of different grammatical forms. The combination of increased grammatical complexity and increased sentence length makes the imitation task more difficult and forces the child to process the sentence in some way.

CHAPTER V

CONCLUSIONS, DISCUSSION AND SUMMARY

This chapter will present a summary of the major findings of the study, a discussion of the present findings in relation to the hypotheses tested as well as to findings of previous studies, and finally a discussion of implications for further research in this area.

Hypotheses Tested

The present study analyzed children's elicited imitation of sentences controlled for sentence length and sentence structure. The following hypotheses were tested:

H_1: When sentence length is held constant, children's ability to repeat sentences correctly will decrease as sentence complexity increases;

H_2: When grammatical complexity is held constant, children's ability to repeat sentences correctly will decrease as sentence length increases;

H_3: Grammatical complexity will exert greater influence than sentence length on children's ability to correctly repeat sentences;

H_4: The influence of grammatical complexity will be shown as a hierarchical structure with more correct repetitions at:
   a. Level 0 than Levels 1, 2, or 3
   b. Level 1 than Levels 2 or 3
   c. Level 2 than Level 3;

H_5: Length of sentence children can correctly repeat will increase with age;

H_6: Complexity of sentence children can correctly repeat will increase with age.

Summary of Major Findings

The results of this study support the hypothesis that both sentence length and sentence complexity are important predictors of children's ability to correctly imitate target sentences. The following are the major results which emerged from the analysis of the children's responses:

1. Children's ability to imitate sentences correctly increases with age.

2. Children's ability to imitate sentences correctly decreases as sentence length increases.

3. There are no significant differences between males and females aged three to five in ability to imitate sentences correctly.

4. The order of difficulty of sentences for imitation can be approximately predicted by the number of major optional transformations manipulated in this study in that those sentences with fewer major transformations are easier to imitate. Negative, question and passive sentences with one transformation in their derivations are easiest to imitate, negative-passive, negative-question, and passive-question sentences with two transformations in their derivations are next in difficulty, and negative-passive-question sentences with three transformations in their derivation are most difficult to imitate. This effect is not completely consistent at all sentence lengths or for all age groups.

5. The transformational history of the sentence is not totally satisfactory in predicting ease of imitation.

SAAD sentences, theoretically closest to the kernel form and containing no major optional transformations, ranged in difficulty from easiest to most difficult but generally were approximately middle in range of difficulty on this imitation task.

6. Sentence length was found to be a highly effective predictor of ability to imitate sentences correctly. It can be tentatively concluded that children have an auditory memory span for sentences which is approximately four words for 3.0-3.5 year olds, six words for 3.6-3.11 year olds, seven words for 4.0-4.5 year olds and eight words for 4.6-4.11 year olds.

7. There was some indication that verb form is an important factor in children's ability to imitate sentences correctly in that sentences with irregular verbs and verbs in the simple past tense were more difficult to imitate than those with regular, present tense verbs.

8. Analysis of specific errors children make on imitation showed most errors were deletion or substitution of words in the sentence. Few permutation errors occurred. Almost no errors of addition were made but many additions of words unrelated to the target sentence were found. Most errors were made on "Y" (articles, prepositions) words, with the greatest number of these errors made on articles. Errors on adjectives comprised the greatest number of "X" word errors. Similar error rates for "X" and "Y" words were found for the older children.

Discussion

The purpose of this section is to discuss the findings of this study relative to both the specific hypotheses tested and to the results of previous research. The hypotheses concerning sentence length will be presented first followed by a discussion of those related to sentence complexity.

Sentence Length

The hypotheses related to sentence length were completely supported by the findings of this study. Hypothesis 2 stated that when grammatical complexity is held constant children's ability to repeat sentences correctly will decrease as sentence length increases. This hypothesis was completely confirmed by the results. Greater numbers of errors occurred on longer sentences and the error rate on all analyses was seen as a steadily increasing function of increase in words per sentence. In general, few errors were made on sentences containing three to six words with a sharp and continuing increase in errors on sentences seven to twelve words in length.

Hypothesis 5, stating that length of sentences children can correctly repeat will increase with age, was also completely supported by the results. From Figure 5 (p. 128) showing the relationship of age to errors on sentences of increasing length, it is demonstrated that although errors steadily increased as sentence length increased, the numbers of errors steadily decreased as age increased. Thus

it was found that the youngest children make the greatest number of errors and the oldest the fewest, with the appropriate predicted relationship for the middle two groups. Based on these results it can be inferred that the 3.0-3.5 year olds have a sentence memory span of about four words, since the error rate for this group increases sharply from five-word sentences on. The 3.6-3.11 year olds make relatively few errors on sentence lengths three to six words and then show a sharp increase in errors. For this group, sentences of approximately six words appear to be the cut-off length for correct or near correct repetitions of sentences. Sentences of seven words or longer show increasing numbers of errors for this group. This may indicate that sentence memory span has been reached at six words for the 3.6-3.11 year olds. For the four year olds no errors are made on sentences from three to six words long and very few errors are made on seven word sentences. For the 4.0-4.5 year olds errors start to increase at eight words. For the 4.6-4.11 year olds the increase in errors is not seen until nine word sentences. These findings suggest that there are sentence memory spans which are different within these four age groups. For generally error-less repetition, sentences no longer than four words for children aged 3.0-3.5, six words for 3.6-3.11 year olds, seven words for 4.0-4.5 year olds and eight words for 4.6-4.11 year olds are suggested for future use in studies of elicited imitation.

These results point to the necessity for controlling sentence length in studies aimed at assessing linguistic skills in children. It may be, as suggested by Fraser, Bellugi and Brown (1963), that sentences shorter than those indicated above do not have to be processed linguistically for correct repetition. The ability to repeat these short sentences may be purely a perceptual-motor skill and the meaning of the sentence immaterial for correct repetition.

It is difficult to compare the present results to previous studies which did not control sentence length and/or which tabulated sentence length by counting morphemes. Recognizing this limitation, it is suggested that these previous studies using imitation were merely assessing rote memory skills rather than sentence processing abilities since sentences used in previous studies were so short; it may be, for example, that in Menyuk's (1963b,1965) studies, the grammatical forms repeated in the shorter sentences did not have to be processed. The errors she found may have been on those sentences exceeding the child's immediate rote memory and thus only reflected difficulties with the grammatical forms exemplified in the longer sentences. Menyuk does not present the imitation errors as a function of sentence length. However, it is possible that sentence length determined success in her studies to some extent, as the longer sentences may contain more complex grammatical forms confounding the analysis of sentence imitation skills. A child may be able

to imitate a grammatically complex sentence if it is short, so that grammatical processing skills are not needed. This is precisely what Slobin and Welsh (1968) found in their analysis of Echo's imitation of complex sentences. In spite of these findings, Menyuk (1963b, 1965, 1969) concludes that length is not critical in determining success of repetition of sentences.

The results of many of the previous studies (e.g., Menyuk, 1963b, 1964a, 1965, 1969; Brown and Fraser, 1963; Fraser, Brown and Bellugi, 1963) need to be re-evaluated in terms of sentence length if hypotheses regarding the use of elicited imitation for inferring linguistic competence in children are to be considered valid. This conclusion is supported by the results of the study of Jon Miller (1970). Miller (1970) found sentence length to be a significant factor in immediate recall of sentences in children. He concludes that sentence length is the best predictor of ease of imitation and that while grammatical structure is important, sentence length as a factor in repetition tasks is independent of surface structure complexity (Yngve depth) or transformational description.

Sentence Complexity

The four hypotheses of this study related to sentence complexity were not completely supported by the results. The results do indicate that complexity, in terms of transformational history, is an important factor in determining correct

sentence repetition. However, the predicted order of difficulty was not completely confirmed.

Hypotheses 1 and 6 were generally supported. When sentence length was held constant, children's ability to repeat sentences correctly does decrease as sentence complexity increases (Hypothesis 1), and the complexity of sentences children can correctly repeat does increase with age (Hypothesis 6). The results of the analysis of variance for Factor T (Figure 2, p. 122) indicate that there is a difference in error scores as a function of sentence type and that there is an increase in errors as sentence complexity increases (although not in the exact predicted order). The results of the TG interactions indicate that as age increases, fewer errors are made. It can therefore be concluded that complexity of sentences children can repeat correctly also increases with age.

It is Hypothesis 4 relating to the hierarchy of predicted difficulty of sentence complexity which is not completely confirmed by the results. Level 3 (NPQ) sentences were found to be generally most difficult, as predicted. More errors occurred on this sentence type than on the other forms. Level 2 sentences (NP, NQ, PQ) also tended to fall in the predicted order of difficulty in that these sentence types tended to be more difficult to repeat than Level 1 and, in some cases, than Level 0 sentences. Level 2 sentences were easier to repeat than Level 3 sentences, as

predicted. It should be noted that the results on Level 2 sentences were more inconsistent than those for Level 3 and appeared to be more dependent on the age of the child and length of the sentence than the Level 3 sentences.

The results for Level 0 and Level 1 sentences, however, did not follow the predicted hierarchy of difficulty and are most difficult to explain. The negative sentences of Level 1 were generally the easiest to repeat (having the fewest errors) on all analyses. These sentences were generally easier than other Level 1 sentences (P and Q) as well as Level 0 (SAAD) sentences. The question form of Level 1 followed the N form in ease of repetition with P (Level 1) sentences more difficult than either of the other two and showing inconsistent findings across ages and sentence lengths. The SAAD sentences (Level 0), predicted to be the easiest sentence type, occupied all rank positions in ease of imitation but tended to fall somewhere in the middle range of difficulty.

A number of explanations in terms of results of earlier studies and theoretical hypotheses can be suggested to account for these results.

The results of such studies as those of Miller (1962), Mehler (1964), Epstein (1961,1962), Savin and Perchonock (1965) supported the coding hypothesis of Miller. The coding hypothesis is only partially supported in the present study. These studies suggested that adults tend to reduce

complex sentences to forms nearer the kernel form on learning, matching and recall tasks. They suggest from this that adults process sentences by reducing complex sentential material to the kernel form with additional footnotes remembered to correspond to each optional transformation in the sentence. Thus sentences of increasing complexity having a greater number of transformations separating them from the kernel form should be more difficult to process. These findings, using adult subjects who have had more linguistic experience with complex sentences, are difficult to compare to findings which relate to the emergence of the same structures in children. However, Slobin (1966) did find some evidence that a kernalization strategy operates in children in grades kindergarten, second, fourth, and sixth (approximate ages 6, 8, 10, and 12 years), in that active sentences are easier for these children to comprehend than passive sentences. The possibility exists that a kernalization strategy is used to respond to some types of linguistic tasks, such as comprehension, but is not used on other linguistic tasks, such as imitation, particularly if short sentences are used on the latter. It is also possible that such sentence processing strategies do not appear until the children are older as they were in Slobin's (1966) study. For children in the present study, it appears that a kernalization strategy is not in complete operation. The insignificant number of permutation errors the children in this study made, however,

presents evidence of the beginnings of a kernalization approach to processing complex sentences. The lack of permutation errors indicates that these children have internalized adult word order rules for the target sentences of the different grammatical types presented for imitation. The fact that more errors occurred in sentences with two or three major optional transformations in their histories suggests that the children are reducing some of these complex sentences to simpler forms. This suggestion must be tentative in view of the very few permutation errors made by the entire population.

Observations of responses of individual children confirm the importance of sentence imitation as a method for assessing the level of linguistic skills and present some further evidence for kernalization strategies in children. On the Question sub-test, several children regularly omitted the word "does/did" and repeated the rest of the sentence with or without the appropriate question marker inflection at the end. It can be inferred from this behavior that these children had not yet developed productive use of the question form but were able to extract the meaning of the sentence and reduce it to a form nearer the SAAD sentence. Some children, also, often did not make the appropriate inflectional changes on the verb in the question sentences. Similar inferences can be drawn about individual children's responses to negative sentences. These children omitted the negative morpheme

from the sentence, thus successfully reducing the sentence to the affirmative form. On passive sentences, several children rearranged word order to the active form but more often substituted the words "for" or "from" for the word "by," resulting in a sentence which was active but ungrammatical. On some of the longer sentences, children often omitted the end of the sentence, often a prepositional phrase, thus producing a grammatical but simpler form. These observations suggest that both content and form of sentences are comprehended to some extent when children imitate sentences. These observations also present evidence of children's reduction of sentences to a simpler, if ungrammatical, form. Some of these findings are at variance with those of Brown and Fraser (1963), in that the responses of the children in the present study did not always correspond to the observations of these authors regarding the words retained on imitation. This discrepancy may be due to the age differences (those in the present study were older) and to the limitations of Brown and Fraser's sentences in terms of length and grammatical forms presented.

The ease of imitation of N and Q sentences may be related to a number of factors. Miller and Ervin (1964) found that inversion of word order for questions and the use of auxiliaries with "not" are among the first transformations children learn. For the most part, the children in the present study appear to have acquired these forms and may be

at the final stages of emergence of N and Q transformations as described by Klima and Bellugi (1966). These children, on the whole, appear to have mastered successfully the auxiliary system, enabling them to correctly imitate negative sentences and yes-no questions. The similarity in the development of these two transformations as described by Klima and Bellugi (1966) is seen in the present study in the similar ease of repetition of N and Q sentences. The children in the present study may be of an age at which they are practicing these two forms and perhaps paying less attention to other grammatical forms. These children may be of an approximate age at which complete understanding of the rules for formulating N and Q sentences is emerging or has taken place. This can be inferred from the results of Klima and Bellugi (1966) since the children in the present study are older and should have passed Klima and Bellugi's third stage in the development of these forms. The newness of the acquisition of these forms and the practice with them may partially explain the greater ease of repetition. If the SAAD sentence type is in fact the easiest, then this form might be so well learned that it can be partially ignored and more effort spent on repeating the newly acquired N and Q transformational types.

Another factor which may account for the ease of repetition of the N and Q forms is the percentage of "X" and "Y" words in these sentence types. As indicated in Chapter IV, the N and Q sentence types have the fewest number of "X"

and "Y" words and the appearance of the words "doesn't/didn't" in N sentences and of "does/did" in Q sentences does not appear to increase the difficulty of repetition. This might be expected if, as indicated, the auxiliary system is developed in these children and the negative form is learned in the early stages of development. An additional factor is suggested here as well. It is possible that the presence of the words "doesn't/didn't" in N sentences and of "does/did" in Q sentences made repetition easier by increasing the predictability of the form of the sentence. After several successive presentations of such sentences, the child may be able to predict the occurrence of these words in succeeding sentences, thus making the imitation task easier by essentially reducing sentence length by one predictable word. The predictability of the sentence frame may not have facilitated imitation of NP, NQ, PQ, and NPQ sentences because the greater grammatical complexity would require the child to predict more than one recurring word in the sentence.

The difficulties the children in this study had in repeating the Level 0 SAAD sentences may also be related to a number of factors.

First, it should be noted that this study confirms the previous findings of Brown and Fraser (1963), Miller and Ervin (1964), and others in terms of word category errors. The children in the present study made more errors on "Y" words than on "X" words, with errors on articles predominant in the former and errors on adjectives in the latter. This

was less true for the older (four year olds) children, who showed similar error rates for both word categories. It would seem that by age four children are equally aware of both "X" and "Y" words and so make similar numbers of errors on both word types. The difficulties in repeating the SAAD sentences may be related, however, to the presence of more "X" words, specifically adjectives, added to increase sentence length on SAAD sentences. Matthews (1968) did find poorer recall scores in adults when adjectives were added to the sentence. The use of adjectives in the present study was suggested by the results of Menyuk (1964b) who found use of the adjective transformation by children aged 2.4 years. However, in terms of transformational complexity, if one concurs with Chomsky (1965) that an additional transformation is needed when adjectives are inserted in a sentence, then one might expect the SAAD form in this test to be more difficult than other types. As many as four additional adjective transformations are needed for the twelve-word SAAD sentence, whereas only two adjective transformations are needed for a twelve-word NPQ sentence and only three for the twelve-word N and Q sentences.

The SAAD sentences are probably also the least predictable in terms of sentence frame form. These sentences contain no recurring words to give major clues as to the form of the sentence, and the child has no learned cues in terms of verb type or tense and presence or absence of adjectives and/or prepositional phrases.

Another possible source for explanation of the differential difficulty with the various grammatical forms is the frequency of occurrence of these different sentence types as the input to the child's LAD. However, the results of the present study are not supported by the findings of Goldman-Eisler and Cohen (1970) who tabulated the frequency of occurrence of various grammatical forms in adult spoken and written language. This type of tabulation is important in relation to the present study in that it is likely that some of the sentence types (P, PQ, NPQ) occur rarely in both adult to adult speech and in the speech they use with children. However, the SAAD sentence was not easiest on this imitation task, even though it is predicted to be easiest in transformational form and is found to occur most frequently in adult speech. Goldman-Eisler and Cohen (1970) also found that negative sentences constitute only four to ten percent of adult utterances. The negative sentences in the present study were found easiest to imitate, demonstrating that the frequency of usage of these forms by adults cannot account for the present findings with children. It is interesting to note that Miller (1970) also found slightly lower error rates for negative sentences on his test of elicited imitation of sentences controlled for length and grammatical structure.

A final possible explanation of the differential difficulty of the sentence types may be related to the presence of obligatory transformations in addition to the optional transformations manipulated in this study. It may be that at

this stage of language acquisition the child is experimenting with and practicing using the optional transformations in his attempts to expand his ability to communicate. Obligatory transformations and transformations which modify the sentence in some way (such as adjective or prepositional phrase transformations) at this stage may have less significance to the child and may be ignored to some extent, causing more difficulties with SAAD sentences which have additional transformations of these types. These difficulties may also reflect differences in acquisition of surface and deep structures in that the optional transformations are theoretically closer to surface structure form of the sentence and hence may interfere less with imitation than the obligatory transformations theoretically nearer the deep structure of the sentence. Undoubtedly a combination of factors relating to both deep and surface structure complexities must be considered in the acquisition of linguistic skills in children.

A final hypothesis regarding sentence complexity needs to be discussed. Hypothesis 3, which states that complexity will exert greater influence than sentence length on children's ability to repeat sentences correctly, must be rejected. First, an initial four factor analysis of variance was done which analyzed first or second attempt, sentence type, sentence length and subjects. This analysis was done for the four age groups and two sexes. The four factor analysis of variance isolated the significant factors in the study but

was a less complete analysis in that it was not designed to analyze the crucial factors of age and sex differences. The results of the four factor analysis showed that for males and females at all four age levels sentence length and sentence type were highly significant (beyond the .01 level of confidence). However, the F ratios for sentence length were almost ten times larger than those for sentence type. (Results on order of sentence complexity and on other factors were similar to those previously reported for the more complete five factor analysis of variance.) Thus sentence length emerges as the most significant factor. The over-all results of the study point to the importance of both sentence length and sentence complexity, but one must conclude that sentence length is the more important determinant of imitation ability.

Other Factors

Two additional factors related to the testing and test instrument should be mentioned in relation to the present findings. These are the attention of the child during the testing and the learning of test items from one sub-test to the next.

Attention of the child and his willingness to complete the task must be considered. Attention to the task cannot account for the findings of this study since all sub-tests were randomized and lack of attention on the sub-tests presented later during testing would equally affect all sentence

types. However, it was noted that as sentences became longer in relation to the child's immediate memory span, that is when he began to make many errors on the sentences, his attention often became less directed to the task. The author believes that attention is a factor related to accuracy of response on longer sentences within sub-tests as well as on sub-tests presented later in the testing session. The author also believes that the current test is too long and that a shorter version, eliminating the shorter sentences on each sub-test, would have produced similar results while keeping the child's attention throughout the test.

There was also some effect of learning, seen particularly with the shorter sentences, and with older subjects who stated that the presented sentence was wrong in some way. Most commonly this effect was in addition or deletion of an adjective. Changes of adjectives made a sentence similar to one of another sentence type of the same length. The effect of learning was also seen in responses of children who reworded a sentence to make it conform to a previously presented sentence form. Some children stated that the negative form of the sentence was wrong and emphasized the affirmative form of the sentence. Some children made statements such as "we already did that one"--indicating that they had remembered the semantic aspects of the same sentence presented in different syntactic form. This effect of learning was less prevalent on longer sentences, further supporting use of long sentences to assess linguistic skills. These results

also present some further support for the notion that long sentences which exceed the child's immediate rote memory span are comprehended or processed on imitation tasks.

Summary and Suggestions for Future Research

The present study assessed the ability of children aged three to five to imitate sentences controlled for both sentence length and sentence complexity. Sentence length was found to be the most significant factor in determining ease of sentence imitation. The number of major optional transformations in the sentence was also found to predict children's difficulties in imitating sentences. Age of the child was an important factor in that as the children got older they were able to correctly repeat longer and more complex sentences. No significant sex differences were found.

The purpose of this study was not to determine whether or not imitated responses are processed or comprehended by children, although some processing and comprehension of sentences was inferred. Some possible evidence and explanations were presented as to the sentence processing strategies these children were using. Sections of the imitation task in this study, as well as sections of previous studies on imitation, comprehension and production of linguistic items, assess different aspects of the child's linguistic knowledge, depending upon the specific level of the tasks required of the subjects and upon the nature of the material presented.

All of these studies, however, are related in that different but related skills are evaluated, all of which are important to the child's acquisition of linguistic competence. It must be concluded that there is not a simple and direct relationship between transformational history and psychological complexity as Garrett and Fodor (1968) have suggested. It must also be concluded that the relationship between transformational history and psychological complexity is highly dependent on the nature of the task and the level of linguistic sophistication of the individuals responding to the task.

From the results of the present study, a number of suggestions for future research can be made. The importance of sentence length in elicited imitation has been demonstrated. All future studies using elicited imitation must carefully control sentence length if implications about children's linguistic competence and inferences about sentence processing strategies are to be drawn. The author believes that future studies should rely on sentences longer than those previously suggested in the literature. Sentences two to eight morphemes as suggested by Slobin (1967), three to six words as suggested by Brown and Fraser (1963), three to nine words (Menyuk, 1963b,1965), and five to nine words (Miller, 1970) are generally too short to assess adequately linguistic skills in children. Sentences of six to ten words probably represents a better range to use, but this range could be appropriately increased or decreased depending on

the age of the children being tested. The longer sentences would be most appropriate as these would give the more reliable estimates of children's linguistic capacities. Using only longer sentences would also shorten the present test, reduce the problem of keeping the child's attention to the task, and allow for greater variations in grammatical sentence types presented for imitation.

In addition to controlling for sentence length, future studies could vary grammatical structure in a number of ways. The present study relied on Miller's (1962) hypothesized relationship between certain types of complex sentences. While his findings presented a useful framework for analyzing sentence processing skills, this particular hierarchy of difficulty may not be as significant to the child developing language as are other forms. The sentence types involving the passive transformation are probably least important to the child, although errors on this sentence type do reflect something about the level of the child's linguistic competence.

In imitation tests the following grammatical variations in sentences of controlled lengths are suggested in order to elicit further information about the development of grammatical skills in children.

1. Other question forms, such as wh-questions and tag questions, could be used.

2. Other combinations of negative and question forms, such as negative tag questions, could also be used.

3. Children's ability to imitate sentences containing various forms of the "do" transformation might be compared. This could be modified to include sentences with the "do" transformation with and without an additional negative transformation.

4. Since the children in the present study had little difficulty with the contracted form of the do plus negative transformation, it may be that the contracted form was repeated as a vocabulary item. Therefore, a comparison might be done of contracted and uncontracted forms of this transformation.

5. Further analysis of children's imitations of sentences with varying numbers of adjectives is also indicated. One way to analyze the development and use of the adjective transformation, as well as to test Chomsky's (1965) theoretical formulations about this transformation, might be to compare sentences of the same length but in different stages of completion of the adjective transformation. Imitation of sentences such as "The horse is black" versus "The black horse is here," might indicate the stages in children's processing of adjective transformations.

6. The present study varied the major optional transformations in the sentence but made no attempt to control the number and type of obligatory transformations in the sentences. Future studies might carefully vary the number and type of both these types of transformations. Word type categories could also be more carefully controlled so that

differences in children's imitations of sentences with varied numbers of word classes could be demonstrated.

7. The present study used truncated passive sentences, having a deletion transformation, only on three and four word sentences. Such sentences were too short to reveal any particular difficulties with this sentence type. Further studies could compare complete and truncated passives in sentences of controlled lengths. This might indicate the differential difficulty of a sentence with a single major transformation, the passive, and one with two transformations needed to generate a similar sentence type, in the truncated passive.

8. Sentences which are controlled for length but which have planned grammatical errors could also be presented for imitation. If, as this study inferred, some sentence processing occurs when immediate memory is surpassed, then children might correct long ungrammatical sentences on repetition in such a way as to indicate the child's current level of linguistic competence. Carefully controlled mutilations of sentences could reveal children's knowledge of obligatory and optional transformations, of morphological rules, and possibly could be used to assess children's knowledge of semantic rules. Similar inferences about linguistic skills might be drawn from analysis of children's imitations of syntactically and/or semantically ambiguous sentences.

Another area for future study is a linguistic analysis of the language of adults to the child at various stages

of language development. If one assumes that LAD attempts to organize input stimuli and to induce rules of the language, then one needs to know the percentage of occurrences of various grammatical forms which are input to the child developing language. While one could assume that the input to LAD is overloaded with SAAD sentences, it may be that negative and question forms, which were easiest to imitate in this study, are equally high in exposure to the child at early stages of development. The child whose linguistic system is in a rudimentary stage may actually hear many negative sentences as warnings from adults about his responses to the environment. The combination of the child's incomplete set of syntactic and phonological rules may require different question forms from adults who fail to understand some of the child's communicative attempts. This situation may increase the occurrence of question forms and hence increased input to LAD. This hypothesis could easily be tested by careful analysis of the percentage of different sentence types in the speech of adults to children at various ages. A child's development and behavior in both linguistic and non-linguistic skills at a particular age may stimulate particular grammatical forms to be used by the adults in communicating with the child and thus may assist the development of one particular grammatical form to the detriment of another at that particular stage of development.

The findings of this study indicate that by controlling sentence length and varying syntactic structure elicited

imitation provides a valuable tool for further assessment of the child's development of linguistic competence.

APPENDIX I

THE TEST OF AUDITORY MEMORY SPAN FOR SENTENCES

SUBTEST 1 - SIMPLE ACTIVE DECLARATIVE SENTENCES (SAAD)

# WORDS		
3	1.	HE EATS FOOD.
3	1.	SHE COOKED DINNER.
4	2.	SHE CLEANS THE ROOM.
4	2.	HE BROKE THE GLASS.
5	3.	THE BOY SEES THE BOAT.
5	3.	THE GIRL CLOSED THE DOOR.
6	4.	THE LADY OPENS THE RED BOX.
6	4.	THE BABY WORE A BLUE DRESS.
7	5.	THE PRETTY GIRL FINDS THE BROWN HAT.
7	5.	THE BLACK HORSE PULLED THE BIG TREE.
8	6.	SHE WASHES THE WHITE CAR IN THE COUNTRY.
8	6.	HE DROVE THE LONG TRAIN TO THE STATION.
9	7.	THE CHILDREN DRAW A LITTLE PICTURE ON THE PAPER.
9	7.	THE BUSY FARMER IN THE YARD WATCHED THE BIRD.
10	8.	THE FAT LADY MOVES THE HEAVY CHAIR ACROSS THE FLOOR.
10	8.	THE MOTHER READ THE LONG STORY TO THE GOOD BOY.
11	9.	THE TALL MAN CATCHES THE YELLOW FISH UNDER THE LARGE ROCK.
11	9.	THE HAPPY FAMILY PLAYED THE WHOLE GAME IN THE GREEN GRASS.
12	10.	THE BAD BOY DROPS THE COLD MILK ON THE CLEAN KITCHEN TABLE.
12	10.	THE RICH MAN BOUGHT THE SHORT GRAY COAT IN THE NEW STORE.

NAME _____ AGE _____ DATE _____

SUBTEST II - PASSIVE SENTENCES (P)

# WORDS		
3	1.	FOOD IS EATEN.
3	1.	DINNER WAS COOKED.
4	2.	THE ROOM IS CLEANED.
4	2.	THE GLASS WAS BROKEN.
5	3.	IT IS SEEN BY HIM.
5	3.	IT WAS CLOSED BY HER.
6	4.	THE BOX IS OPENED BY HER.
6	4.	IT WAS WORN BY THE BABY.
7	5.	THE HAT IS FOUND BY THE GIRL.
7	5.	THE TREE WAS PULLED BY THE HORSE.
8	6.	IT WAS WASHED IN THE COUNTRY BY HER.
8	6.	IT WAS DRIVEN TO THE STATION BY HIM.
9	7.	A PICTURE IS DRAWN ON THE PAPER BY THEM.
9	7.	IT WAS WATCHED BY THE FARMER IN THE YARD.
10	8.	THE CHAIR IS MOVED ACROSS THE FLOOR BY THE LADY.
10	8.	THE STORY WAS READ TO THE BOY BY THE MOTHER.
11	9.	THE YELLOW FISH IS CAUGHT UNDER THE ROCK BY THE MAN.
11	9.	THE GAME WAS PLAYED IN THE GREEN GRASS BY THE FAMILY.
12	10.	THE MILK IS DROPPED ON THE CLEAN KITCHEN TABLE BY THE BOY.
12	10.	THE SHORT GRAY COAT WAS BOUGHT IN THE STORE BY THE MAN.

NAME _____ AGE _____ DATE _____

SUBTEST III - NEGATIVE SENTENCES (N)

# WORDS		
3	1.	HE DOESN'T EAT.
3	1.	SHE DIDN'T COOK.
4	2.	SHE DOESN'T CLEAN IT.
4	2.	HE DIDN'T BREAK IT.
5	3.	HE DOESN'T SEE THE BOAT.
5	3.	SHE DIDN'T CLOSE THE DOOR.
6	4.	THE LADY DOESN'T OPEN THE BOX.
6	4.	SHE DIDN'T WEAR A BLUE DRESS.
7	5.	THE PRETTY GIRL DOESN'T FIND THE HAT.
7	5.	THE HORSE DIDN'T PULL THE BIG TREE.
8	6.	SHE DOESN'T WASH THE CAR IN THE COUNTRY.
8	6.	HE DIDN'T DRIVE THE TRAIN TO THE STATION.
9	7.	THE CHILDREN DON'T DRAW A PICTURE ON THE PAPER.
9	7.	THE FARMER IN THE YARD DIDN'T WATCH THE BIRD.
10	8.	THE LADY DOESN'T MOVE THE HEAVY CHAIR ACROSS THE FLOOR.
10	8.	THE MOTHER DIDN'T READ THE LONG STORY TO THE BOY.
11	9.	THE TALL MAN DOESN'T CATCH THE FISH UNDER THE LARGE ROCK.
11	9.	THE HAPPY FAMILY DIDN'T PLAY THE WHOLE GAME IN THE GRASS.
12	10.	THE BAD BOY DOESN'T DROP THE COLD MILK ON THE CLEAN TABLE.
12	10.	THE RICH MAN DIDN'T BUY THE GRAY COAT IN THE NEW STORE.

NAME _____ AGE _____ DATE _____

SUBTEST IV - QUESTION SENTENCES (Q)

# WORDS		
3	1.	DOES HE EAT?
3	1.	DID SHE COOK?
4	2.	DOES SHE CLEAN IT?
4	2.	DID HE BREAK IT?
5	3.	DOES HE SEE THE BOAT?
5	3.	DID SHE CLOSE THE DOOR?
6	4.	DOES SHE OPEN THE RED BOX?
6	4.	DID THE BABY WEAR A DRESS?
7	5.	DOES THE GIRL FIND THE BROWN HAT?
7	5.	DID THE BLACK HORSE PULL THE TREE?
8	6.	DOES SHE WASH THE CAR IN THE COUNTRY?
8	6.	DID HE DRIVE THE TRAIN TO THE STATION?
9	7.	DO THE CHILDREN DRAW A PICTURE ON THE PAPER?
9	7.	DID THE FARMER IN THE YARD WATCH THE BIRD?
10.	8.	DOES THE LADY MOVE THE HEAVY CHAIR ACROSS THE FLOOR?
10.	8.	DID THE MOTHER READ THE STORY TO THE GOOD BOY?
11	9.	DOES THE MAN CATCH THE YELLOW FISH UNDER THE LARGE ROCK?
11	9.	DID THE FAMILY PLAY THE WHOLE GAME IN THE GREEN GRASS?
12	10.	DOES THE BOY DROP THE COLD MILK ON THE CLEAN KITCHEN TABLE?
12	10.	DID THE MAN BUY THE SHORT GRAY COAT IN THE NEW STORE?

NAME _____ AGE _____ DATE _____

SUBTEST V - NEGATIVE-PASSIVE SENTENCES (NP)

# WORDS		
3	1.	FOOD ISN'T EATEN.
3	1.	DINNER WASN'T COOKED.
4	2.	THE ROOM ISN'T CLEANED.
4	2.	THE GLASS WASN'T BROKEN.
5	3.	IT ISN'T SEEN BY HIM.
5	3.	IT WASN'T CLOSED BY HER.
6	4.	THE BOX ISN'T OPENED BY HER.
6	4.	A DRESS WASN'T WORN BY HER.
7	5.	THE HAT ISN'T FOUND BY THE GIRL.
7	5.	THE TREE WASN'T PULLED BY THE HORSE.
8	6.	IT ISN'T WASHED IN THE COUNTRY BY HER.
8	6.	IT WASN'T DRIVEN TO THE STATION BY HIM.
9	7.	A PICTURE ISN'T DRAWN ON THE PAPER BY THEM.
9	7.	IT WASN'T WATCHED BY THE FARMER IN THE YARD.
10	8.	THE CHAIR ISN'T MOVED ACROSS THE FLOOR BY THE LADY.
10	8.	THE STORY WASN'T READ TO THE BOY BY THE MOTHER.
11	9.	THE FISH ISN'T CAUGHT UNDER THE LARGE ROCK BY THE MAN.
11	9.	THE WHOLE GAME WASN'T PLAYED IN THE GRASS BY THE FAMILY.
12	10.	THE COLD MILK ISN'T DROPPED ON THE KITCHEN TABLE BY THE BOY.
12	10.	THE GRAY COAT WASN'T BOUGHT IN THE NEW STORE BY THE MAN.

NAME _____ AGE _____ DATE _____

SUBTEST VI - NEGATIVE-QUESTION SENTENCES (NQ)

# WORDS		
3	1.	DOESN'T HE EAT?
3	1.	DIDN'T SHE COOK?
4	2.	DOESN'T SHE CLEAN IT?
4	2.	DIDN'T HE BREAK IT?
5	3.	DOESN'T HE SEE THE BOAT?
5	3.	DIDN'T SHE CLOSE THE DOOR?
6	4.	DOESN'T SHE OPEN THE RED BOX?
6	4.	DIDN'T THE BABY WEAR A DRESS?
7	5.	DOESN'T THE PRETTY GIRL FIND THE HAT?
7	5.	DIDN'T THE HORSE PULL THE BIG TREE?
8	6.	DOESN'T SHE WASH THE CAR IN THE COUNTRY?
8	6.	DIDN'T HE DRIVE THE TRAIN TO THE STATION?
9	7.	DON'T THEY DRAW A LITTLE PICTURE ON THE PAPER?
9	7.	DIDN'T THE BUSY FARMER IN THE YARD WATCH IT?
10	8.	DOESN'T THE FAT LADY MOVE THE CHAIR ACROSS THE FLOOR?
10	8.	DIDN'T THE MOTHER READ THE LONG STORY TO THE BOY?
11	9.	DOESN'T THE TALL MAN CATCH THE YELLOW FISH UNDER THE ROCK?
11	9.	DIDN'T THE HAPPY FAMILY PLAY THE GAME IN THE GREEN GRASS?
12	10.	DOESN'T THE BAD BOY DROP THE MILK ON THE CLEAN KITCHEN TABLE?
12	10.	DIDN'T THE RICH MAN BUY THE SHORT COAT IN THE NEW STORE?

NAME _____ AGE _____ DATE _____

SUBTEST VII - PASSIVE-QUESTION SENTENCES (PQ)

# WORDS		
3	1.	IS FOOD EATEN?
3	1.	WAS DINNER COOKED?
4	2.	IS THE ROOM CLEANED?
4	2.	WAS THE GLASS BROKEN?
5	3.	IS IT SEEN BY HIM?
5	3.	WAS IT CLOSED BY HER?
6	4.	IS THE BOX OPENED BY HER?
6	4.	WAS IT WORN BY THE BABY?
7	5.	IS THE HAT FOUND BY THE GIRL?
7	5.	WAS THE TREE PULLED BY THE HORSE?
8	6.	IS IT WASHED IN THE COUNTRY BY HER?
8	6.	WAS IT DRIVEN TO THE STATION BY HIM?
9	7.	IS IT DRAWN ON THE PAPER BY THE CHILDREN?
9	7.	WAS IT WATCHED BY THE FARMER IN THE YARD?
10	8.	IS THE CHAIR MOVED ACROSS THE FLOOR BY THE LADY?
10	8.	WAS THE STORY READ TO THE BOY BY THE MOTHER?
11	9.	IS THE FISH CAUGHT UNDER THE ROCK BY THE TALL MAN?
11	9.	WAS THE WHOLE GAME PLAYED IN THE GRASS BY THE FAMILY?
12	10.	IS THE COLD MILK DROPPED ON THE KITCHEN TABLE BY THE BOY?
12	10.	WAS THE GRAY COAT BOUGHT IN THE STORE BY THE RICH MAN?

NAME _____ AGE _____ DATE _____

SUBTEST VIII - NEGATIVE-PASSIVE-QUESTION SENTENCES (NPQ)

# WORDS		
3	1.	ISN'T FOOD EATEN?
3	1.	WASN'T DINNER COOKED?
4	2.	ISN'T THE ROOM CLEANED?
4	2.	WASN'T THE GLASS BROKEN?
5	3.	ISN'T IT SEEN BY HIM?
5	3.	WASN'T IT CLOSED BY HER?
6	4.	ISN'T IT OPENED BY THE LADY?
6	4.	WASN'T THE DRESS WORN BY HER?
7	5.	ISN'T THE HAT FOUND BY THE GIRL?
7	5.	WASN'T THE TREE PULLED BY THE HORSE?
8	6.	ISN'T IT WASHED IN THE COUNTRY BY HER?
8	6.	WASN'T IT DRIVEN TO THE STATION BY HIM?
9	7.	ISN'T A PICTURE DRAWN ON THE PAPER BY THEM?
9	7.	WASN'T IT WATCHED BY THE FARMER IN THE YARD?
10	8.	ISN'T THE CHAIR MOVED ACROSS THE FLOOR BY THE LADY?
10	8.	WASN'T THE STORY READ TO THE BOY BY THE MOTHER?
11	9.	ISN'T THE YELLOW FISH CAUGHT UNDER THE ROCK BY THE MAN?
11	9.	WASN'T THE GAME PLAYED IN THE GRASS BY THE HAPPY FAMILY?
12	10.	ISN'T THE MILK DROPPED ON THE KITCHEN TABLE BY THE BAD BOY?
12	10.	WASN'T THE SHORT COAT BOUGHT IN THE NEW STORE BY THE MAN?

NAME _____ AGE _____ DATE _____

APPENDIX II

SUMMARIES OF ANALYSES OF VARIANCE FOR THREE- TO TWELVE-WORD SENTENCES

Summary of Analysis of Variance For Three-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	0.246	1	0.246	
T	15.515	7	2.216	13.45**
AT	0.363	7	0.051	
S	1.346	4	0.336	
AS	0.400	4	0.100	
TS	14.927	28	0.533	3.23**
ATS	6.365	28	0.227	
X	1.310	1	1.310	
AX	0.061	1	0.061	
TX	1.083	7	0.154	
ATX	0.541	7	0.077	
SX	6.537	4	1.634	
ASX	0.561	4	0.140	
TSX	13.112	28	0.468	2.84**
ATSX	2.458	28	0.087	
G	15.886	3	5.295	7.55**
AG	0.066	3	0.022	
TG	15.330	21	0.730	4.42**
ATG	2.662	21	0.126	
SG	5.087	12	0.423	
ASG	1.238	12	0.103	
TSG	34.372	84	0.409	2.48**
ATSG	13.480	84	0.160	
XG	2.139	3	0.713	
AXG	0.474	3	0.158	
TXG	5.671	21	0.270	
ATXG	3.709	21	0.176	
SXG	8.412	12	0.701	
ASXG	1.840	12	0.153	
TSXG	35.048	84	0.417	2.53**
ATSXG	13.846	84	0.164	
TOTAL	224.100	639		

**Significant at .01 level

Summary of Analysis of Variance For Four-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	0.289	1	0.289	
T	7.921	7	1.131	13.96**
AT	0.340	7	0.048	
S	4.121	4	1.030	
AS	0.824	4	0.206	2.54*
TS	16.389	28	0.585	7.22**
ATS	2.006	28	0.071	
X	0.042	1	0.042	
AX	0.006	1	0.006	
TX	1.588	7	0.226	2.79*
ATX	0.226	7	0.032	
SX	8.266	4	2.066	
ASX	0.335	4	0.083	
TSX	12.683	28	0.452	5.58**
ATSX	1.726	28	0.061	
G	10.834	3	3.611	
AG	0.224	3	0.074	
TG	11.368	21	0.541	6.67**
ATG	1.338	21	0.063	
SG	9.107	12	0.758	
ASG	0.632	12	0.052	
TSG	30.056	84	0.357	4.41**
ATSG	5.446	84	0.064	
XG	1.690	3	0.563	
AXG	0.589	3	0.196	
TXG	10.438	21	0.497	6.13**
ATXG	2.083	21	0.099	
SXG	15.064	12	1.255	
ASXG	1.792	12	0.149	
TSXG	30.130	84	0.358	4.42**
ATSXG	6.808	84	0.081	
TOTAL	194.376	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance for Five-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	0.006	1	0.006	
T	3.101	7	0.443	3.92**
AT	0.469	7	0.067	
S	4.432	4	1.108	
AS	0.631	4	0.157	
TS	5.735	28	0.204	1.81*
ATS	1.868	28	0.066	
X	3.035	1	3.035	
AX	0.040	1	0.040	
TX	1.533	7	0.219	
ATX	1.317	7	0.188	
SX	12.151	4	3.037	
ASX	0.413	4	0.103	
TSX	9.920	28	0.354	3.14**
ATSX	3.268	28	0.116	
G	28.973	3	9.657	3.76*
AG	0.696	3	0.232	
TG	7.679	21	0.365	3.24**
ATG	2.931	21	0.139	
SG	5.960	12	0.496	
ASG	0.729	12	0.060	
TSG	25.608	84	0.304	2.70**
ATSG	9.291	84	0.110	
XG	6.030	3	2.010	
AXG	0.151	3	0.050	
TXG	7.721	21	0.367	3.25**
ATXG	2.104	21	0.100	
SXG	30.760	12	2.563	
ASXG	0.796	12	0.066	
TSXG	23.444	84	0.279	2.47**
ATSXG	9.474	84	0.112	
TOTAL	210.281	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance For Six-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	0.380	1	0.380	
T	9.099	7	1.299	11.48**
AT	0.711	7	0.101	
S	6.502	4	1.625	
AS	0.168	4	0.042	
TS	7.185	28	0.256	2.26**
ATS	3.126	28	0.111	
X	1.972	1	1.972	
AX	0.306	1	0.306	
TX	1.833	7	0.261	2.31*
ATX	0.544	7	0.077	
SX	20.844	4	5.211	
ASX	0.233	4	0.058	
TSX	13.790	28	0.492	4.34**
ATSX	4.701	28	0.167	
G	50.639	3	16.879	4.04*
AG	2.122	3	0.707	6.24**
TG	10.462	21	0.498	4.40**
ATG	3.348	21	0.159	
SG	13.344	12	1.112	
ASG	0.585	12	0.048	
TSG	24.949	84	0.297	2.62**
ATSG	10.837	84	0.129	
XG	14.239	3	4.746	
AXG	0.016	3	0.005	
TXG	10.941	21	0.521	4.60**
ATXG	1.379	21	0.065	
SXG	50.066	12	4.172	
ASXG	1.431	12	0.119	
TSXG	26.584	84	0.316	2.79**
ATSXG	9.512	84	0.113	
TOTAL	310.862	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance For Seven-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	1.142	1	1.142	7.68**
T	8.165	7	1.166	7.85**
AT	0.588	7	0.084	
S	7.524	4	1.881	
AS	0.600	4	0.150	
TS	12.551	28	0.448	3.01**
ATS	2.582	28	0.092	
X	1.528	1	1.528	
AX	0.089	1	0.089	
TX	1.891	7	0.270	
ATX	1.511	7	0.215	
SX	32.157	4	8.039	
ASX	0.675	4	0.168	
TSX	10.287	28	0.367	2.47**
ATSX	2.329	28	0.083	
G	80.078	3	26.692	4.80*
AG	0.943	3	0.314	
TG	5.426	21	0.258	1.73*
ATG	3.993	21	0.190	
SG	23.580	12	1.965	
ASG	1.398	12	0.116	
TSG	30.552	84	0.363	2.44**
ATSG	8.834	84	0.105	
XG	25.544	3	8.514	
AXG	0.101	3	0.033	
TXG	3.306	21	0.157	
ATXG	2.513	21	0.119	
SXG	66.626	12	5.552	
ASXG	1.291	12	0.107	
TSXG	24.525	84	0.291	1.96**
ATSXG	12.485	84	0.148	
TOTAL	374.826	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance For Eight-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	4.557	1	4.557	21.27**
T	24.621	7	3.517	16.41**
AT	1.127	7	0.161	
S	6.239	4	1.559	
AS	0.778	4	0.194	
TS	19.711	28	0.703	3.28**
ATS	4.289	28	0.153	
X	0.000	1	0.000	
AX	0.109	1	0.109	
TX	3.150	7	0.450	
ATX	2.640	7	0.377	
SX	29.300	4	7.325	
ASX	0.732	4	0.183	
TSX	13.893	28	0.496	2.31**
ATSX	5.511	28	0.196	
G	108.814	3	36.271	8.65**
AG	2.173	3	0.724	3.38*
TG	8.710	21	0.414	1.93*
ATG	4.876	21	0.232	
SG	22.381	12	1.865	
ASG	2.750	12	0.229	
TSG	51.499	84	0.613	2.86**
ATSG	16.867	84	0.200	
XG	10.110	3	3.370	
AXG	0.665	3	0.221	
TXG	7.591	21	0.361	
ATXG	4.350	21	0.207	
SXG	50.295	12	4.191	
ASXG	3.982	12	0.331	
TSXG	44.330	84	0.527	2.46**
ATSXG	18.000	84	0.214	
TOTAL	474.063	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance For Nine-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	12.883	1	12.883	52.97**
T	29.586	7	4.226	17.37**
AT	12.691	7	1.813	7.45**
S	6.529	4	1.632	
AS	2.729	4	0.682	2.80*
TS	11.376	28	0.406	1.67*
ATS	11.356	28	0.405	1.66*
X	1.225	1	1.225	
AX	0.322	1	0.322	
TX	4.983	7	0.711	2.92**
ATX	2.475	7	0.353	
SX	43.670	4	10.917	
ASX	1.122	4	0.280	
TSX	15.020	28	0.536	2.20**
ATSX	10.089	28	0.360	
G	118.428	3	39.476	9.42**
AG	2.285	3	0.761	3.13*
TG	14.133	21	0.673	2.76**
ATG	8.157	21	0.388	
SG	62.729	12	5.227	
ASG	4.317	12	0.359	
TSG	40.419	84	0.481	1.97**
ATSG	26.659	84	0.317	
XG	21.837	3	7.279	
AXG	2.373	3	0.791	3.25*
TXG	8.569	21	0.408	
ATXG	3.594	21	0.171	
SXG	50.255	12	4.187	
ASXG	8.691	12	0.724	2.97**
TSXG	40.071	84	0.477	1.96**
ATSXG	20.433	84	0.243	
TOTAL	599.019	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance For Ten-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	3.840	1	3.840	13.11**
T	21.926	7	3.132	10.69**
AT	1.732	7	0.247	
S	11.270	4	2.817	
AS	0.772	4	0.193	
TS	17.734	28	0.633	2.16**
ATS	14.772	28	0.527	1.79*
X	4.481	1	4.481	
AX	0.217	1	0.217	
TX	3.970	7	0.567	
ATX	0.946	7	0.135	
SX	51.761	4	12.940	
ASX	2.099	4	0.524	
TSX	12.373	28	0.441	
ATSX	5.718	28	0.204	
G	159.289	3	53.096	13.04**
AG	1.342	3	0.447	
TG	16.490	21	0.785	2.68**
ATG	6.124	21	0.291	
SG	65.081	12	5.423	
ASG	4.365	12	0.363	
TSG	53.123	84	0.632	2.16**
ATSG	26.972	84	0.321	
XG	22.878	3	7.626	
AXG	1.775	3	0.591	
TXG	7.120	21	0.339	
ATXG	5.739	21	0.273	
SXG	48.858	12	4.071	
ASXG	9.978	12	0.831	2.84**
TSXG	47.798	84	0.569	1.94**
ATSXG	24.591	84	0.292	
TOTAL	655.150	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance For Eleven-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	2.513	1	2.513	5.80*
T	2.916	7	0.416	
AT	2.484	7	0.354	
S	20.180	4	5.045	
AS	1.779	4	0.444	
TS	12.395	28	0.442	
ATS	9.066	28	0.323	
X	0.321	1	0.321	
AX	0.012	1	0.012	
TX	3.844	7	0.549	
ATX	2.881	7	0.411	
SX	43.456	4	10.864	
ASX	1.532	4	0.383	
TSX	15.455	28	0.551	
ATSX	15.057	28	0.537	
G	167.276	3	55.758	11.17**
AG	8.079	3	2.693	6.23**
TG	10.101	21	0.481	
ATG	6.916	21	0.329	
SG	79.048	12	6.587	
ASG	4.620	12	0.385	
TSG	41.827	84	0.497	
ATSG	33.750	84	0.401	
XG	38.788	3	12.929	
AXG	1.053	3	0.351	
TXG	9.622	21	0.458	
ATXG	7.990	21	0.380	
SXG	59.901	12	4.991	
ASXG	4.822	12	0.401	
TSXG	53.642	84	0.638	1.47*
ATSXG	36.351	84	0.432	
TOTAL	697.693	639		

**Significant at .01 level
*Significant at .05 level

Summary of Analysis of Variance For Twelve-Word Sentences
Attempt X Sentence Type X Subjects
X Sex X Age Groups
(ATSXG)

Source of variation	SS	df	MS	F
A	4.567	1	4.567	15.83**
T	14.342	7	2.048	7.10**
AT	2.496	7	0.356	
S	8.752	4	2.188	
AS	2.006	4	0.501	
TS	28.074	28	1.002	3.47**
ATS	12.160	28	0.434	
X	2.770	1	2.770	
AX	0.002	1	0.002	
TX	5.533	7	0.790	2.73*
ATX	3.457	7	0.493	
SX	27.257	4	6.814	
ASX	2.433	4	0.608	
TSX	13.366	28	0.477	1.65*
ATSX	8.892	28	0.317	
G	175.266	3	58.422	12.69**
AG	3.087	3	1.029	3.56*
TG	13.095	21	0.623	2.16**
ATG	6.851	21	0.326	
SG	95.497	12	7.958	
ASG	7.489	12	0.624	2.16*
TSG	55.504	84	0.660	2.29**
ATSG	26.719	84	0.318	
XG	41.205	3	13.735	
AXG	1.914	3	0.638	
TXG	13.726	21	0.653	2.26**
ATXG	9.121	21	0.434	
SXG	55.243	12	4.603	
ASXG	5.842	12	0.486	
TSXG	59.611	84	0.709	2.45**
ATSXG	24.237	84	0.288	
TOTAL	730.528	639		

**Significant at .01 level
*Significant at .05 level

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