MEMORY FOR VERBAL SEQUENCES AS A FUNCTION OF THEIR SYNTACTICAL STRUCTURE AND THE AGE OF THE RECALLING CHILD* 1

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A. INTRODUCTION

One of the difficulties in assessing the development of syntax in the language of young children lies in the discrepancy between the structure of the utterances the child normally emits and the structure of the utterances of other speakers to which the child is able to respond. Children make responses to structured verbal sequences that they can not or do not ordinarily emit on their own (7). The present study concerns itself with an examination of the preschool child's ability to respond differentially to verbal sequences varying in syntactical structure.

Some of the more common structured word sequences—e.g., simple declarative sentences like "I see you."—may be first perceived as single units due to the fact that one of the major formal separations characteristic of written language—namely, separation between words—is not consistently made explicit in speech and is therefore not available to the nonreading young child. Kagan (5) has suggested that inflection and loudness function as the stimulus characteristics that make these units perceptually salient in the child's verbal environment. Such units are acquired early and, due to their high frequency of occurrence in English, become very strong responses.

As the child is exposed to more adult speech, he begins to perceive the various parts of these gross single units as units themselves. The process by which this comes about is that of discrimination: shorter phrases, or words, or morphemes are heard in different verbal contexts and in this way acquire a unitary aspect of their own. Evidence for the effect of the discriminative properties of bound morphemes has been given in experiments using nonsense syllables as basic word stems (1, 2, 11). Given such a constantly increasing

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repertoire of discriminated units, we find that single words become the primary unitary form. In time the child can handle, in addition to the refined small units, such as words, all the earlier "units," such as simple sentences, now in the form of syntactically linked sequences.

Assuming that children are exposed to a corpus of English that represents more general English speech, the extent to which the various units cohere for the child should gradually tend to approximate the frequency with which such units are found in English. More specifically, if we measure the strength of these units by the ability of the child to recall word sequences ordered in various ways, the extent of the increase in recall for a given word sequence should depend upon how often its parts are heard in sequence or as single units, and how often they are broken up in English speech.

The present study is designed to examine the strength of cohesion of these syntactical units for children between the ages of 3 and 6 years. Making the assumption that the linking of words through the discriminative properties that constitute their syntactical structure reduces the number of units that need to be encoded in an immediate memory situation (9, 10), we have used a recall measure as an index of the strength of the syntactical structure, and reorderings of a simple declarative sentence as a way of varying the degree of syntactical structure in the stimulus material. More specifically, the declarative structure was presented intact and with mutilations occurring in less and less likely positions: *viz.*, subject—predicate, verb—object, noun—modifiers, and complete reversal of word order. If the extent of the children's recall is positively related to the relative frequency characteristics of the various word sequences, we can conclude that the children have in fact made the discriminations necessary for utilizing the structures in encoding. If we find no order of recall consistent with the relative frequency characteristics of English word orders, we can conclude that the children have not yet made the necessary discriminations. Such children—i.e., very young children—might still be functioning at a stage where only the gross initial units can be utilized to improve recall; other subdivisions of these units can not yet be discriminated by them and therefore can not increase their ability to recall such sequences over word sequences arranged in random order.

The study, furthermore, was set up to examine both short (four-word) sequences as well as long (six-word) sequences with the purpose of replicating the effect of disruption of syntactical structure on sequences that tax the memory span in this age range to different degrees.
B. Method

1. Subjects

The Ss consisted of 49 children, ranging in age from 3 to 6 years, who attended a private day nursery and kindergarten. The group can be characterized as middle class with most of the children coming from professional and semiprofessional homes.

2. Apparatus

The apparatus consisted of a table upon which was placed a large burlap screen to separate the S from the E. In front of the screen, on S’s side of the table, was a papier-maché clown mounted in a colorful box; his nose was made of a 7½-watt red light bulb which could be turned on and off by E. The same apparatus was used previously in a study on operant conditioning of speech (12). A transparent plastic chute, through which small trinkets could be delivered, was imbedded in the screen and fed into a small clear plastic box on the table next to the clown. A wooden toy mallet was also placed on the table in front of S. Two tape recorders were placed on E’s side of the screen, one for presenting to S the stimulus word sequences that were recorded in the clown’s voice, and the other for recording S’s attempted imitation of the word sequences. A foot pedal for controlling the presentation of stimulus sequences and a microphone which was hung around S’s neck completed the apparatus. The entire testing area of the room was enclosed with striped drapes resembling a circus tent.

3. Procedure

Before testing the Ss individually, the two Es visited them in their classrooms and read them an illustrated story about the adventures of “Happy the Clown.” The story not only served the purpose of introducing the clown but also elicited from the Ss, in a familiar setting, the types of responses later required during individual testing.

Each S was then brought individually into the experimental room which, he was told, was “Happy’s tent.” S was seated in front of the papier-maché clown at the table and the microphone was placed around his neck. The two

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2 Stephen Wise Free Synagogue Nursery School and Kindergarten. The authors would like to acknowledge the excellent cooperation they received from both the school and the synagogue, and particularly express their appreciation to Mrs. Regina Gilbert, the school director, and her staff and Rabbi Edward Klein.
Es showed him the clown, the trinket box and chute, and the mallet, and then told him that the clown would speak to him and play games with him.

The clown then partly sang, partly spoke the following tape-recorded instructions (Sr indicates reinforcement):

(Whistling). I'm so happy (Sr₁ = clown's nose lighting up), I'm so happy (Sr₁), I'm so ha-pa-pa-ha-pa-pa happy (Sr₁). Whoops, well hi there. My name is Happy. What's yours? (S's response) (Sr₁). That's a nice name. Say, how do you like that? Whenever I’m happy my nose lights up. You know what? I like you. If you say “hello” to me I'll give you a present. (S’s response) (Sr₁) (Sr₂ = delivery of trinket). Do you remember how we said “boo” to the lion? Well, if you say “boo” for me now, I'll give you another present. (S’s response) (Sr₁) (Sr₂).

The clown then instructed S to imitate two identical series of stimuli, one of rhythmic “boos” and one of rhythmic mallet taps. Every response was followed by Sr₁ and Sr₂. The following instructions were then given by the clown for the verbal response task:

Great! You're just great. You're just wonderful. Say, do you know my favorite game? (S's response) (Sr₁). Well, I call it silly mixed-up words. The silly mixed-up words I say are so silly and so ridiculous that even ferocious lions laugh at me. Say, I'll bet that you can say some of my favorite mixed-up words. O.K.? (S's response) (Sr₁). Now listen carefully, and after you hear me say my silly thing then you say it right after me. O.K.? (S's response) (Sr₁).

Twelve sequences of words were then presented, one at a time, for S to imitate. If S's response was not correct, the word sequence was repeated once for 3-year-old Ss and, if necessary, twice for older Ss before Sr₁ and Sr₂ were delivered. Reinforcement was withheld only if S refused to attempt imitation. Analysis of these data was based only on the first attempted imitation. Five different types of word sequences were used: (a) simple declarative sentence, (b) reversal of subject and predicate, (c) reversal of verb and object, (d) reversal of noun and modifier, and (e) complete reversal of declarative sentence. Two sequence lengths, one four words and the other six words,
were used to sample each type of reordered sequence. The following is one of the four lists used in the experiment:

Practice 1 — The fox plays games.
Practice 2 — The black wolf likes short coats.

3a — The horse pants wears.
3b — The young pig new hats buys.
1b — The old cow chews pink gum.
1a — The dog reads books.
5a — Eggs eats mouse the.
5b — Pants tight wears horse fat the.
4b — Dog small the reads books good.
4a — Cow the chews gum.
2a — Buys hats the pig.
2b — Eats cold eggs the white mouse.

The first two sequences were identical on all four lists. A schematic representation of the makeup of the four lists is shown in Table 1. Lists I and III

<table>
<thead>
<tr>
<th>Content A</th>
<th>Content B</th>
</tr>
</thead>
<tbody>
<tr>
<td>List I</td>
<td>List II</td>
</tr>
<tr>
<td>3a</td>
<td>3b</td>
</tr>
<tr>
<td>3b</td>
<td>4a</td>
</tr>
<tr>
<td>1b</td>
<td>2a</td>
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<tr>
<td>1a</td>
<td>2b</td>
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<td>5a</td>
<td>1b</td>
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<tr>
<td>5b</td>
<td>1a</td>
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<tr>
<td>4b</td>
<td>5a</td>
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<td>4a</td>
<td>5b</td>
</tr>
<tr>
<td>2a</td>
<td>5b</td>
</tr>
<tr>
<td>2b</td>
<td>3a</td>
</tr>
</tbody>
</table>

*Note: The numbers 1, 2, 3, 4, and 5 refer to the different types of word orders; and a and b refer to four- and six-word sequences, respectively.*

and lists II and IV are identical in content. Lists I and II and lists III and IV are identical in terms of the order of presentation of the different types of word sequences. Lists I and IV and lists II and III are identical in terms of the order of presentation of four- and six-word sequences.

Each S was tested twice, the time interval between the test and retest being approximately three months. Ss were given lists at retest that differed in content from their test list but in which the order of types was the same. Most of the Ss were retested in the same order in which they were tested, but because of absences this was not always possible. Forty-nine Ss were tested initially and
45 of the Ss were retested. The remaining four Ss were not available for retesting for reasons unrelated to the experiment.

As a comparison group, seven college students were presented with one of the tape-recorded stimulus lists and asked to write down their responses.

C. Results

Five age groups of nine children each were formed of the 45 children who had been given both the test and retest. To achieve the groupings, the children were ordered according to their age at the time of initial testing and successive groups of nine were taken to constitute each group. The mean ages and age ranges for each group can be found in Table 2.

<p>| Table 2: Mean Age and Age Range in Years for Each of Five Age Groups |</p>
<table>
<thead>
<tr>
<th>Age group</th>
<th>Test</th>
<th>Retest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>Age range</td>
</tr>
<tr>
<td>I</td>
<td>3.2</td>
<td>3.0-3.3</td>
</tr>
<tr>
<td>II</td>
<td>3.6</td>
<td>3.4-3.7</td>
</tr>
<tr>
<td>III</td>
<td>4.0</td>
<td>3.8-4.4</td>
</tr>
<tr>
<td>IV</td>
<td>4.5</td>
<td>4.4-4.7</td>
</tr>
<tr>
<td>V*</td>
<td>5.0</td>
<td>4.8-5.8</td>
</tr>
<tr>
<td>Total</td>
<td>4.1</td>
<td>3.0-5.8</td>
</tr>
</tbody>
</table>

* One of the children in this group was considerably older than the others.

Each child's recall of a given stimulus word sequence was scored in two ways: (a) the largest number of correct words recalled in the order presented—the longest sequence recalled, and (b) the number of correct words recalled independent of order. Analyses of variance using a three-way layout in a mixed model (13) were applied separately to the two types of scores (mean longest sequence recalled and mean number of correct words recalled) at both test and retest for the four- and six-word sequences in order to determine the effect of age and structure of sequences on recall.

Figure 1 presents the means of the longest sequence of words recalled as a function of age with syntactical structure represented as a parameter.

Significant differences among the age groups were found (p < .05). Inspection of Figure 1 shows that the increase in age is positively related to an increase in recall scores for the four- and six-word sequences at test and retest. This result holds as well for data scored as mean number of correct words recalled (p < .01).

Differences in recall of the five types of word sequences when scored as the mean longest sequence correct (see Figure 2) were found to be statistically
significant for both the four- and six-word sequences at both test and retest ($p < .005$). The data show that immediate memory decreases with reorderings of a simple declarative structure in such a way that best recall is found for the intact declarative sentence (1), next best for the subject and predicate reversal (2), next for the reversal of verb and object (3), next for the reversal of nouns and their modifiers (4), and poorest for the complete sentence re-

![Graphs showing memory recall as a function of age with syntactical structure varied as a parameter.](Image)

**FIGURE 1**

**Recall as a Function of Age with Syntactical Structure Varied as a Parameter**
versal (5). The data represented by mean number of words recalled yielded the same results ($p < .005$).

The interaction between age and recall of the different sequences represented by the mean longest sequence correct as tested by the analysis of variance indicates no statistically significant effect ($p > .05$). Figure 1 shows that memory

![Figure 1](image)

**Figure 1**

Recall as a Function of Differences in the Word Order of Stimulus Sequences

for the different word sequences lines up at each age essentially as it does for the entire group. This result holds for retest as well as test despite a general rise in memory for most word sequences at most ages.

The result holds for recall scores of number of words correct ($p > .05$) except for the four-word retest condition ($p < .025$), which is most prob-
ably due to a ceiling artifact produced by a combination of conditions that makes the task too easy for the children.

Comparable data on the group of seven adults showed generally the same relative ordering among recall scores of the different types of word sequences. The mean longest sequence recalled for adults is plotted as a discontinuous point on the graphs for initial test on Figure 1 for purposes of comparison with the children, although these data were not included in the analysis of variance.

Any comparison of memory for four- or six-word sequences confronts one with the choice of (a) comparing the absolute recall scores directly, without correcting for obvious differences in number of words in the stimulus sequences or (b) equating for differences in the length of the stimulus sequences by dividing by very small numbers (four and six) to obtain proportions that are highly unstable. For this reason, only a descriptive comparison was attempted. The interpretation is in accord with both tabulations. As the types of stimulus word sequences presented become less like English syntax, recall deteriorates more for the six-word than the four-word sequences, to the extent that fewer words of the longer sequences were actually recalled for the less common structures (see Figure 2). This was borne out by consideration of the proportion of words constituting the mean longest sequence recalled as well. Taking the proportion for the intact declarative sentence as a baseline and subtracting the proportions of recall for each of the other sequences from it, we find that these differences, which can be considered as a measure of the disruptive effect of modifying the sequences, show that reordering of the declarative sentence produces relatively greater deficits in recall of six- than four-word sequences as the structures become less common to English syntax. In both cases the data suggest that further study, using materials that tax the memory span more than those employed in the present study, would be advisable.

D. Discussion

The results show that preschool children are sensitive to English syntactical structure and suggest that they rely upon it to reduce the number of units they must encode when listening to verbal sequences. In general, the order in which the modification of syntactical structure reduced recall remained constant throughout the age range studied and probably reflects the relative frequency of occurrence with which these structures are found as units or sequences in English. It appears, therefore, that by three years of age children have already developed responses to speech that reflect these general linguistic
frequency characteristics. Further development shows a general increase in the ability to recall verbal sequences but maintains the relative order of response to speech characterized by various syntactical structures. The same ordering was also reflected in the performance of adult subjects, particularly where six-word sequences—which tax the memory span—were used. A similar lack of interaction of grammatical forms with age was also reported in a study by Martin and Jones (8), who found no difference between children and college students.

Furthermore, in a study by Karpova (6) as cited in (3), which tested 5 to 7 year olds' awareness of the units in sentences, the ordering of units to which the children responded coincided well with the ordering of units that aided in recall in the present study. Karpova found first that children tended to hear sentences in two parts: namely, a subject and a predicate. The children in this study recalled this reordered sequence almost as well as the intact declarative sentence. When more than two parts were heard, they were most often concrete nouns, then verbs and adjectives, and least often function words. The children had great difficulty in recalling reversed noun-modifier pairs where the modifier always included the function word "the."

The fact that breaking up a declarative sentence into its subject and predicate produces little observable difference from recall of the intact sentence, and Karpova's finding that children hear sentences as a separate subject and predicate, suggests that these phrases may be the basic perceptual units for encoding simple declarative sentences. Martin and Jones (8) also found a similar type of equivalence between single words and certain phrases in an associative learning task.

That certain syntactically linked word sequences do function as units was indicated by Huttenlocher (4), who found in a study of 4½- to 5-year-old children that being able to separate word pairs was a critical factor in the ability to reverse members of the same pairs. As a result, members of grammatical pairs were found to be more difficult to reverse than nongrammatical pairs. If syntactical structure does function in such a way as to produce units, then words that occur together most frequently should be most difficult to recall if they are reordered. Such seems to be the case in the present study.

There is some indication, although not conclusive, in the present study that the syntactical structure of a verbal sequence becomes increasingly critical for recalling that sequence as its length increases beyond that of the memory span. It appears that extreme modification of common syntax may even produce an interference effect such that longer sequences, which when syntactically
structured enable Ss to recall a great deal of information, come to be less well recalled than are shorter sequences. Such a notion would be consistent with Miller’s chunking hypothesis (9) and could be easily tested further in a study that varied more extensively the length of sequences as a parameter of the experiment.

E. Summary

Based on the assumption that the syntactical structure in a sequence of words reduces the number of units that a listener must process, 45 preschool children, aged 3 to 6 years, were tested on their immediate memory for various reordering of a declarative sentence.

Recall increased with age and similarity of the verbal sequence to the usual structure of a simple declarative sentence. The results were interpreted to demonstrate the early development of the child’s sensitivity to linguistic frequency characteristics of English: i.e., the frequency with which parts of speech occur in given orders.

References


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