Young children's comprehension of complex sentences.

Marilyn. Kippax

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LA THÈSE A ÉTÉ MICROFILMÉE TELLE QUE NOUS L'AVONS RÉCU
YOUNG CHILDREN'S COMPREHENSION
OF COMPLEX SENTENCES

by

MARILYN KIPPAK

A Thesis
Submitted to the Faculty of Graduate Studies
through the Department of Psychology
in Partial Fulfillment of the Requirements
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ABSTRACT

The purpose of the present study was to determine the age at which the child becomes capable of comprehending complex sentence structures, and to assess his method of processing them before he reaches a level of full comprehension. Forty-eight children aged 3 to 5 years were presented with a series of complex sentences with right, left and center embedded clauses. They were asked to act them out with toys placed in front of them. In a second session they were presented with an imitation task, using a similar list of sentences. Taken together these measures allowed for an evaluation of the degree of comprehension at a given age and indicated the child's approach to processing.

It was hypothesized that with right and left embedded sentences young children would act out the first clause more often than the second (i.e. they would select the first noun-verb-noun sequence). With center embedded sentences, it was hypothesised that three year olds would not be able to act out either clause. General improvement in comprehension with increased age was also expected.

Children do seem to rely on a first NVN strategy in comprehending complex sentences, but become less dependent on such a strategy as they increase in age. The findings generally support previous statements regarding children's use of such a strategy.
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CHAPTER I

INTRODUCTION

There have been many studies investigating the young child's production and comprehension of sentences (See Brown, 1968; Slobin, 1973; for review). These studies have generally focused on specific aspects, such as, whether comprehension of various sentence types precedes production, and the order of acquisition of various sentence types, such as passives, wh questions, negatives. There have been few studies, however, investigating children's comprehension of complex sentences. Investigators such as Bever (1970), and Slobin (1978) have dealt with the comprehension of passive sentences, but the study of complex sentences containing two clauses has been relatively neglected. A few studies (Bever, 1970; Clark, 1971; Lahey, 1974) have been undertaken to determine the strategies children use to comprehend complex sentences containing two clauses. These authors have generally found that word order tends to be an extremely important linguistic cue in the young child's comprehension of sentences of this type.

Bever (1970) has suggested that the young child develops four processing strategies which are heavily dependent on word order. The four strategies are as follows: (1) "Strategy A" which states that the listener organizes the words making up a sentence into segments of "actor-action-object...modifier".
(2) "Strategy B" which states that children select the first Noun...Verb...(Noun) sequence, which is segregated by "Strategy A" as the main clause, unless the verb is marked as subordinate.

(3) "Strategy C" which states that constituents are functionally related internally by semantic constraints.

(4) "Strategy D" which states that any noun-verb-noun (NVN) sequence in the surface structure corresponds to "actor-action-object" or "subject-verb-object": Only Strategies A, B, and D, however, are relevant to the present study since we are investigating whether children do in fact rely on a first NVN strategy to comprehend these sentences.

Strategy A which states that the young child will organize words making up a sentence into "actor-action-object...modifier" only applies when the three units are semantically related. Bever has looked at a number of sentence structures containing main and subordinate clauses. He states that the need for Strategy A may arise from the fact that some sentences contain more than one clause.

In order to interpret these types of constructions, not only must the different clause's be segregated from each other, but also one must determine the internal relation between the
two clauses. Bever suggests that children use another strategy to help them interpret such sentences. This second strategy he labels "Strategy B". He states that children select the first N...V...(N) sequence which is isolated by Strategy A as the main clause, unless the verb is marked as subordinate. Studies (Lahey, 1974; Clark, 1971) have indicated, however that a young child selects the first noun-verb-noun sequence as the main clause regardless of the fact that the verb is marked as subordinate. It would appear that the young child uses only a part of Strategy B, and only fully employs this strategy later on.

In investigating the use of Strategy B, Bever asked young children to act out sentences such as the following: (a) The cow that jumped walked away. and (b) The cow jumped and walked away. Bever stated that the clause they acted out in sentence (a) would give some insight into which clause the children thought contained the most important information. Bever's results indicated that children between the ages of 1½ and 2½, who acted out both actions poorly in sentence (b) acted out only the subordinate clause (first action) in sentence (a). Those who did well in acting out sentence (b) acted out the main clause (second action) in sentence (a). Therefore, the children at the beginning of language acquisition pick the first N...V...(N) sequence as the most important part of the sentence, and appear to be following only part of Strategy B. More advanced children acted out the main clause, and according to Bever
considered it to be more important.

Strategy B, however, applies only when the sentence is in normal word order (i.e. main-subordinate clause). What happens when the subordinate clause is first or embedded within the main clause? When this is the case the first NNV sequence is not the subject-verb-object of the main clause. In these cases one might expect that the use of Strategy B would not enable the young child to correctly comprehend the complex sentence.

Bever's statement of Strategy D is based on observations of children acting out simple sentences with dolls. Three structural contrasts have been investigated: actives versus passives (e.g. "The cow kisses the horse." versus "The horse is kissed by the cow."); subject versus object clefts (e.g. "It's the cow kisses the horse." versus "It's the cow the horse kisses."); and NNV versus VNN nonsense sequences (e.g. "The cow the horse kisses." versus "Kisses the cow the horse."). The pertinent observation was that 2 year olds interpreted the noun directly preceding the main verb as the logical subject. Level of performance was greater than chance in all of the above types of constructions, where there is a noun immediately preceding the main verb (Bever, Foror, and Garrett, 1974). In the case of passives or VNN sequences the level of performance was no better than chance. Bever suggested that this was due to the fact that children are relying on Strategy D which does not allow correct comprehension.
In a study conducted by Lahey (1974), it was concluded that young children rely on the word order of a sentence to enable them to process the sentence. Lahey compared 4 and 5 year olds' comprehension of coordinate sentences, center-embedded relative clause sentences, and right-branching relative clause sentences. The sentences were presented under four conditions: (1) with both prosody (intonation, stress and durational aspects) and syntactic markers (morphological inflections, and function words), (2) with markers but no prosody, (3) with prodody but no markers, and (4) neither prosody nor markers. The following pair of sentences are examples of these with and without markers: (a) The sheep hit the deer and chased the sheep. (b) Cow hit horse chase sheep. The children were asked to act out sentences with toy animals. The number of semantic-syntactic relationships that were acted out, were analyzed by age, sentence type, and condition of presentation. Lahey found that center embedded sentences (e.g. "The cow that hit the pig, chased the sheep." ) were easier to understand than right branching sentences (e.g. "The cow hit the pig that chased the sheep." ); which were most difficult to understand. Age appeared to be a significant factor. More relationships were acted out appropriately by 5 year olds than 4 year olds. The conditions of presentation, however, did not significantly affect the child's responses: The elimination of prosody did not significantly affect the comprehension of the sentences, nor did the elimination of syntactic markers. Lahey interpreted this to mean that young children do not use prosody
or syntactic markers to determine the relationships among words within a sentence, and that word order is the major linguistic cue.

The use of Bever's Strategy B may explain why right-branching sentences were more difficult to understand. In right-branching sentences the referent of the relative clause may be ambiguous, i.e. the child may not know which noun the clause is modifying. For example in the sentence cited earlier: "The cow hit the pig that chased the sheep." (R.B.), the child may not be sure whether the clause 'that hit the sheep' refers to the cow or the pig, since both nouns precede the verb. In the center-embedded sentences, on the other hand, the noun ('the cow') directly precedes the clause ('that hit the pig') by which it is modified.

The results of H.D. Brown's (1971) study of the comprehension of relativized sentences by 3, 4, and 5 year olds, also lend some support to Bever's hypothesis that children overuse Strategy B. In that study, 3 year olds found sentences containing center-embedded clauses relatively easier to comprehend than right-embedded sentences. For example, (a) "The man who is wearing a hat is talking to the lady." (C.E.) was easier to understand than (b) "A lady is talking to the man who is wearing a hat." (R.E.). These results are similar to those of Lahey. She also found that center-embedded sentences were easier to comprehend than right-branching sentences, which
were most difficult to understand.

Several other studies that have been conducted using complex sentences have also indicated that word order is an important linguistic cue. Clark (1971) conducted a study with children aged 3 years 2 months to 4 years 11 months. She used complex sentences containing the temporal conjunctions before and after. She stated that temporal relations are communicated relatively early through the temporal arrangement of verbal elements, that is, what happened first is mentioned first. Results of this study indicated that children use a simple strategy involving word order to interpret these complex sentences, before they know what the conjunctions before and after mean. Young children relied almost exclusively on an order-of-mention strategy to describe events in time. They treated complex sentences containing before and after as if they were two simple sentences, and assumed the 'first' clause describes Event I, and the 'second' clause describes Event II. This strategy appears to be very much like Bever's Strategy B in that children pick the 'first' clause which is the first NVN sequence to be Event I.

If children follow such a strategy, they should make errors in interpreting sentences in which the order of the clauses does not mirror order of occurrence. Amidon and Carey (1972) studying kindergarten children found that greater attention was paid to
main clauses regardless of clause order, thus order-of-mention was not a dominant strategy for their 5 year olds. They found that the frequent errors with before and after were not random, but often involved a command introduced by the conjunctions before and after. These children obeyed the command in the main clause, but tended to ignore the command in the subordinate clause. The authors stated that the difficulty experienced was not due to demands on short-term memory, since sentences containing identical commands connected by and were easily understood by the children. The authors gave instructions containing right and left embedded clauses, (e.g.; (a) "Before you move a red plane, move a blue plane.", (b) "Move a blue plane, before you move a red plane.", (c) "After you move a blue plane, move a red plane.", (d) "Move a red plane, after you move a blue plane."). They concluded that kindergarten children's difficulty in understanding complex sentences with temporal relations depends on whether the sentences contain subordinate clauses. They stated that there was no difference in 5 year olds ability to comprehend sentences containing before vs. after. They suggested that difficulty in comprehension was due to syntactic instead of semantic complexity, depending on where the subordinate clause was located in the sentence. Again, word order appears to be of prime importance. Sentences, such as, "We sang songs before we went to bed." were much easier to comprehend than "Before we went to bed, we sang songs." because the subordinate clause followed the main clause.
Bever (1970) found that adult subjects had a stylistic preference for sentences in which the subordinate clause followed the main clause. The relative complexity of sentences in which the first verb is a subordinate verb can be demonstrated. Bever considered sentences such as the following pair: (a) "It amazed Bill that John left the party angrily." and (b) "That John left the party angrily amazed Bill." The first sentence (a) was judged by adults as the less complex version. Bever states that this is because the subordinate verb is not the first verb in the sentence. This is related to the processing of two clauses. In the less complex version the main clause appears first, and so is already processed before the subordinate clause is introduced. When the subordinate clause is in the first position, a short term memory difficulty appears. Researchers (Bever, 1970; Watt, 1969) suggest that by the time one has processed the main clause, the subordinate clause has been forgotten. In a general study of subject preference, Bever and Weksel (1965) found that subjects had a stylistic preference for sentences in which the subordinate clause followed the main clause, e.g. (a) "The dog bit the cat because the food was gone." was preferred over (b) "Because the food was gone, the dog bit the cat."

Bebout, Segalowitz, and White (1978) conducted a similar study, but used sentences containing causal conjunctions rather than temporal conjunctions. Sentences which were reality congruent and reality non-congruent were presented to children in grades 1 through 4. They used complex sentences, such as,
(a) The pencils moved, so the car moved.
(b) Because the ruler moved, the glasses moved.
(c) The ruler moved, because the car moved.

A grade by sentence type interaction was detected. There was minimal improvement with age on reality congruent (i.e., order of clauses mirrors order of occurrence), but there was considerable improvement on reality non-congruent (order of clauses does not mirror order of occurrence) sentence types. Again, it appears that children do rely on the word order of a sentence and, perhaps more specifically, on the use of Bever's Strategy B to comprehend such sentences. This difference between reality congruent and non-congruent sentence types disappears between grades 3 and 4. Thus, children seem to acquire the ability to fully comprehend complex sentences containing causal conjunctions around the age of nine.

Bever (1970) also concluded that sentences were easier to comprehend when the order-of-mention corresponded to order of occurrence. The difference between Amidon and Carey's results and those of Clark (1971) and Bever (1970) may be the result of developmental differences that emerge between the ages of 3 and 5. Amidon and Carey state that if strategies for interpreting sentences change with age, order-of-mention may be important during early stages of language development, but then becomes subordinated to other strategies by the age of 5.

Other studies have indicated that children may use strategies
other than those depending on word order. Bever in stating that young children use a word order strategy is suggesting that surface structure properties may be more important for comprehension, than properties on any other level. In contrast to Bever's argument, Townsend and Erb (1975) argue for the use of a strategy that necessitates more grammatical competence. Townsend and Erb stated that when children encounter sentences they have difficulty processing, they interpret only the main clause. In their study, subjects were children between the ages of 3 and 6. They were asked complex comparative questions, such as, "Which box is taller than it is fat?". Most subjects simply responded by selecting the tallest object, i.e., they focused only on the first clause rather than on a combination of the two. Townsend and Erb concluded that these children interpreted only the main clause. But the results are confounded by the fact that the main clause is always the 'first' clause. The authors do, however, allow for other possible interpretations and acknowledge that the children may be focusing on the 'first' clause. But they state this is due to the fact they have learned that the second clause contains less important information. The implication is that children are competent to judge whether a clause is main or subordinate, and know that the main clause has more important properties. This capability may imply something deeper than surface structure cues. But can we assume young children are competent to make these judgements? Perhaps they are in fact, more generally employing a strategy of position, and are focusing only on the 'first' clause. One could easily test,
by reversing the word order (i.e. putting the subordinate clause first), whether children have in fact acquired a rule as Townsend and Erb propose. By reversing the word order, the subordinate clause would no longer be in the final position. Would the main clause then be tagged as the one containing the less important information? One would expect from Townsend and Erb's argument that they would still be able to distinguish between main and subordinate clauses.

The aim of the present study was to attempt to determine which strategy young children use in comprehending complex sentences. Is the young child using a strategy which depends primarily on word order (i.e. the first noun-verb-noun is subject-verb-object)? Or is he using a rule such as Townsend and Erb suggest (therefore being able to distinguish between main and subordinate clauses)?

If the child is in fact attending to one of these strategies, at what age is he able to fully comprehend sentences containing main and subordinate clauses? There appear to be three points of view. Townsend and Erb suggested that 3 year olds are able to comprehend this type of sentence. Bever has suggested that 4 year olds are still dependent on a word order strategy. Thus according to Bever, 3 year olds are not able to comprehend complex sentences. Brown's (1971) results using relativized sentences showed a significant main effect for age: Three year olds performed poorer than 4 year olds on all sentence types. Four year
olds did not differ significantly form 5 year olds, even though cell means for the latter were higher. Brown states that in "relativized structures (and perhaps other structures) children may reach a point around 4 years of age where the developmental growth curve levels off, with little increase in the next year" (Brown, 1972, p. 1929). These findings seem to parallel those of Bever that 4 year olds tend to overgeneralize the word order strategy. Brown does not refer directly to word order, but rather to embeddedness, which is basically word order. He states that 3 year olds can comprehend center-embedded sentences to some degree, but find right-embedded sentences more difficult to comprehend. The 4 and 5 year olds' performance was better on right-embedded sentences that that of 3 year olds, with 5 year olds being slightly, but not significantly better than 4 year olds.

In summary, then we can see a difference of opinion among researchers regarding the strategy being employed to comprehend sentences containing main and subordinate clauses. There is also an empirical discrepancy regarding the age at which the child is able to comprehend complex sentences. Townsend and Erb state that 3 year olds are capable of distinguishing the two clauses. Brown suggests they can only comprehend center-embedded sentences. Judging by some of Bever's results, one should expect that the child would not be able to comprehend this type of sentence until the age of 5 or 6. If this is the case, then the 3 year old child would have trouble comprehending center-embedded sentences.
For this reason, center-embedded sentences, as well as right and left-embedded sentences have been employed in the present study. By looking at center-embedded sentences one can further see whether a child is using a first NVN strategy, such that he will select the first noun, first verb and the nearest noun following the verb as subject-verb-object of the main clause. The child may then take the subordinate clause object as the main clause object, in center-embedded sentences. Right-embedded sentences have also been included since the order of the first clause (i.e. noun-verb-noun) is not disrupted. Left embedded sentences have been included to further test the use of Strategy B in young children. In left embedded sentences, the main clause is in the second position, so if the young child is using Strategy B, he will consistently act out the subordinate clause. If children consistently act out the subordinate clause in this type of sentence, it can be concluded that they are relying on Strategy B as Bever has suggested.

Both temporal and causal subordinate conjunctions were employed in the sentences. Studies have indicated that there is no difference in performance on sentences containing before and after, nor on sentences containing because, since, or so. But none have indicated whether there is any difference between sentences containing temporal conjunctions and those containing causal conjunctions. One further aim of the study, then was to test whether the use of before, after, or because affects the child's comprehension of complex sentences.
In the present study there were four major hypotheses:

(1) A general improvement with age was expected in the ability to comprehend complex sentences. It was expected that the ability to both act out 2 clauses, and act them out in the correct order would increase with age.

(2) With both right, and left-embedded sentences it was expected that the first clause would be acted out more often than the second clause. That is, the main clause would be acted out more often with right-embedded sentences and the subordinate clause would be acted out more often in left-embedded sentences.

(3) With center-embedded sentences, it was expected that 3 year olds would not be able to act out either clause, while older children would show a greater ability to act out both.

(4) It was also expected that, since Bebout et al.'s 6 to 9 year olds still had difficulty with causal complex structures, but 5 year olds (and some 3 and 4 year olds) understand temporal complex sentences (Clark), that temporal sentences would be easier to comprehend than causal sentences. While there are no data available on 3 to 5 year olds' comprehension of causal complex sentences, based on an extrapolation from 6 to 9 year olds' data, it was expected that 3 to 5 year olds' performance would be poor.
CHAPTER II

METHOD OF INVESTIGATION

Subjects

Forty-eight subjects from English speaking families were selected from two nursery schools. Sixteen children were chosen from each of three age groups; 3, 4, and 5 year olds. There were 34 boys and 14 girls.

Sentences

The sentences were selected so that in all three sentence types either subject could be the actor of either verb, and either object could be the object of either verb. Thus some degree of semantic ambiguity was present within the sentence. Since the purpose of the present study was to test for children's linguistic ability, it was necessary to use sentences containing such ambiguity to eliminate the possibility that children would use extra-linguistic cues in comprehension (See Bever, 1970 cited earlier). If sentences in which it is quite clear what the correct subject should be were used (e.g. "The dog barked after the cat purred."); it would not be clear whether the child understands this type of sentence, nor what strategy he is using.

Two different lists of sentences were used. Half the subjects were given List A, and half the subjects were given List B, for the comprehension task. Each list also contained 2 different random orders. Each list contained 4 examples of
of each of the three sentence types; right, left and center-embedded. Within each sentence type, two sentences contained temporal conjunctions, one containing before, the other after. The other two sentences of each type contained causal conjunctions. (See Table 1 for List A(1). See Appendix for lists of other sentence presentations). For the imitation task 6 sentences were selected from the opposite list from which the comprehension sentences were selected. There were also 2 single clause sentences of approximately the same length as the two clause sentences. These were included to test for memory limitations (See procedure below).

Procedure

Subjects were tested individually in the nursery school, in a room away from the other children. Upon entering the room, the child was seated at a table across from the experimenter. Toys were already placed on the table. After the child was seated he was asked if he would like to play a game. If the child refused he was excused. Each child was observed under three different tasks; (1) comprehension, (2) knowledge of conjunctions and (3) imitation. Testing was carried out in two sessions; the comprehension and knowledge of conjunctions tasks on one day and the imitation task on another day. This was done in order to reduce fatigue and to reduce the possibility of confusion between the two lists. Each session took approximately 15 minutes.

(1) Comprehension Task:
Table 1
List A(1)

Comprehension Task:

1. The car hit the tree, before the truck ran over the ball. (R.E.)
2. Because the girl pulled the wagon, the boy rode his bike. (L.E.)
3. The man looked for the hammer, after the lady found the key. (R.E.)
4. The boy, after the little girl carried the cup, threw the ball. (C.E.)
5. The truck, before the tractor pushed the car, pulled the wagon. (C.E.)
6. Before the man opened the box, the lady closed the door. (L.E.)
7. The dog chewed the sock, because the cat played with the ball. (R.E.)
8. Because the dog ran around the room, the baby crawled to mommy. (L.E.)
9. The boy, because the girl sat on the truck, washed the car. (C.E.)
10. After her father sat down on the chair, the girl played with the dog. (R.E.)
11. The horse chewed the shoe, because the cow kicked the pail. (L.E.)
12. The girl, because her mother picked up the doll, carried the purse. (C.E.)

Imitation Task:

1. The dog, because the cat played with the ball, chewed the sock. (C.E.)
2. The black and white tom cat drank the small bowl of milk.
3. Because her mother picked up the doll, the girl carried the purse. (L.E.)
4. The car, before the truck ran over the ball, hit the tree. (C.E.)
5. The brown and white farm dog chased the big flock of sheep.
6. The boy rode his bike, because the girl pulled the wagon. (R.E.)
7. Before the tractor pushed the car, the truck pulled the wagon. (L.E.)
8. The girl played with the dog, after father sat down on the chair. (R.E.)
For the comprehension task each child was given 12 complex sentences consisting of four with right-embedded clauses, four with left-embedded clauses, and four with center-embedded clauses. The experimenter instructed the child that she would like him to act out with the toys, what she said. Each subject was given one practice sentence. The experimenter would say: "Show me 'The boy washed the car, before his mother drove the truck.'" The child was then expected to select the appropriate toys and act out the sentence with the toys. If the child could not act out the sentences, he was excused from the study. Recordings were made on how the child acted out the sentence. For example in the practice sentence assuming the child acted out the sentence correctly the experimenter would write down: (1) boy washed car, (2) mother drove truck. When recording whether the child acted out correctly, any action that could be taken as a correct actions was scored as correct. For example in the practice sentence rubbing the boy doll on the car would serve as a correct response.

(2) Knowledge of Conjunctions Task:
This task was included to see if the child understood the meanings of before, after and because. Each child was shown 6 pictures (2 to test each word) of familiar children's stories; (1) Goldilocks and the Three Bears, (2) Cinderella. The child was then asked a question pertaining to the picture, e.g. 'What did Goldilocks do before she went upstairs to lay down on the bed?' The picture shown would be a picture of Goldilocks going upstairs.
All children received the same 6 questions and were shown the same pictures. If a child did not understand the meanings of before, after or because, it was decided that he would be dropped from the study. In fact, all subjects obtained perfect scores on this task and, thus no subjects were eliminated. (See Table 2 for questions.)

(3) Imitation Task:

Within one week of the original testing the child was given the imitation task. Each child was read 8 sentences for the imitation task. The experimenter asked the child to repeat what she had said to him. There were two sentences of each type (right, left and center-embedded), and two sentences with only one clause of the same number of words as the comprehension sentences. The imitation task was included to determine whether the child had sufficient storage space to store seven items. It was assumed that if the child could remember at least seven words, then he should be able to remember two sequences of NVN and the conjunction (a total of 7 words). Therefore, if the child was able to repeat the sentences, failure to comprehend on the comprehension task cannot be attributed simply to inadequate storage space in memory.

Scoring

(1) Comprehension Task:

Each sentence was scored in the same manner. First the number of clauses acted out correctly regardless of clause order
Table 2

Knowledge of Conjunctions

1. What did Goldilocks do before she went upstairs and lay down on the bed?
2. What did the three bears find after they came back from their walk?
3. What did Cinderella's fairy godmother do before Cinderella went to the ball?
4. What happened after the Prince put the glass slipper on Cinderella's foot?
5. Why was Goldilocks running out of the window?
6. Why was Cinderella so sad?
was recorded. The sentence was scored 0, 1, or 2. Secondly, sentences were scored for correct clause order. Here the sentence was scored 0 or 1: 1 for correct order and 0 for incorrect order. Next the correct number of elements acted out was scored. The maximum score for each sentence was 6. This scoring reflected only whether the correct objects and correct actions were selected regardless of the combination in which they were performed. A score of 6 was recorded if all 6 elements were included. Then the number of correct transitions was recorded. In this case the number of correct pairings of noun and verb was recorded. The maximum score for each sentence was 4. To obtain a score of 4, the child would have to pair together subject number (1) with verb number (1), verb number (1) with object number (1) etc. Finally, whether the first clause acted out (regardless of whether 1 or 2 clauses were acted out) was main or subordinate was recorded.

(2) Knowledge of Conjunctions Task:

For the knowledge of conjunctions task the number of questions answered correctly was recorded. The maximum number here was 6.

(3) Imitation Task:

Each sentence was scored separately for the imitation task as was done in the comprehension task. The number of elements repeated was first recorded. This refers to the same elements discussed under the comprehension task. Again the maximum was 6. Next the number of transitions was recorded. Again this is the
same as in the comprehension task, and the maximum score for
each sentence was 4. Finally, the number of words repeated was
recorded. This varied slightly by sentence but the total for
each sentence was 10-12 words.

Analyses
Several analyses were performed. There were two analyses
of variance, one to determine whether there were any list or order
effects, and a second to determine if there was an age trend in
the ability to comprehend complex sentences. Binomial tests were
conducted to determine: (1) whether the main or subordinate
clause was acted out more often within the different sentence
types, at each age level, and (2) whether the first NVN
sequence was focused on more often than any other sequence at
each age level. Chi square tests were employed to investigate
whether; (1) picking the first NVN or another sequence and age
were independent; (2) the first NVN, main or subordinate clause
is selected more often in center-embedded sentences; (3) age and
selecting correct order are dependent. Lastly, t test analyses
were conducted to investigate whether there was a difference
between the comprehension and imitation tasks in the number of
elements or transitions remembered. To further test for the
memory factor, t tests were again employed to determine whether
the children remembered less than 7 words.
CHAPTER III
RESULTS

List and Order Effects

The possibility of any list and order effects was investigated by means of a preliminary 2(list) x 2(order) x 2(performance measure) x 3(age) analysis of variance, with repeated measures on the second factor (order), nested under the first factor (list) (See Table 3).

No significant effects attributable to list or to order within the list were detected ($F=.78, df=1;44$ (list); $F=.59, df=2;44$ (order); all $p>.05$). Embeddedness and performance measures (i.e. number of elements and transitions acted out) were the only two significant factors ($F=11.33, df=2;44$ (Emb.); $F=46.11, df=1;22$ (P.M.); all $p<.05$). Finding a significant effect attributable to performance measure is trivial since the possible number of elements is greater than the possible number of transitions. Since neither list nor order main effects were detected nor did these factors interact with any of the variables of interest, list and order were collapsed in further analyses.

Age Trend

A second analysis of variance was carried out in order to test for age differences. This involved a $3(age) x 3(embeddedness) x 2(performance measure)$ analysis. Age was found to be a significant main effect ($F=27.50, df=2;45, p<.05$) (See Table 4). Embeddedness and performance measures were also significant
Table 3

Sources of variance for list effect analysis

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>List</td>
<td>14.67</td>
<td>1</td>
<td>14.67</td>
<td>.78</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Orderw/in L</td>
<td>22.37</td>
<td>2</td>
<td>11.19</td>
<td>.59</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Error A</td>
<td>829.54</td>
<td>44</td>
<td>18.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perf Meas</td>
<td>3982.78</td>
<td>1</td>
<td>3982.78</td>
<td>48.11</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>List x Perf M</td>
<td>.03</td>
<td>1</td>
<td>.03</td>
<td>.0004</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Ord x Perf M</td>
<td>.04</td>
<td>2</td>
<td>.02</td>
<td>.0002</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Error C</td>
<td>1821.39</td>
<td>22</td>
<td>82.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embeddedness</td>
<td>1010.84</td>
<td>2</td>
<td>505.42</td>
<td>11.33</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>List x Emb</td>
<td>14.88</td>
<td>2</td>
<td>7.44</td>
<td>.17</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Ord x Emb</td>
<td>139.28</td>
<td>4</td>
<td>34.82</td>
<td>.78</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Error D</td>
<td>1963.16</td>
<td>44</td>
<td>44.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perf M x Emb</td>
<td>1.90</td>
<td>2</td>
<td>.95</td>
<td>.08</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>List x P M x Emb</td>
<td>.19</td>
<td>2</td>
<td>.09</td>
<td>.007</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Ord x P M x Emb</td>
<td>1.02</td>
<td>4</td>
<td>.25</td>
<td>.02</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Error CD</td>
<td>537.99</td>
<td>44</td>
<td>12.23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.
Sources of variance for age trend

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1520.53</td>
<td>2</td>
<td>760.27</td>
<td>27.50</td>
<td>.05</td>
</tr>
<tr>
<td>Error Age</td>
<td>1244.12</td>
<td>45</td>
<td>27.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embeddedness</td>
<td>1125.47</td>
<td>2</td>
<td>562.75</td>
<td>52.20</td>
<td>.05</td>
</tr>
<tr>
<td>Age x Emb</td>
<td>8.13</td>
<td>4</td>
<td>2.03</td>
<td>.18</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Error B</td>
<td>970.07</td>
<td>90</td>
<td>10.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perf Meas</td>
<td>4125.35</td>
<td>1</td>
<td>4125.35</td>
<td>939.72</td>
<td>.05</td>
</tr>
<tr>
<td>Age x Perf M</td>
<td>51.44</td>
<td>2</td>
<td>25.72</td>
<td>5.86</td>
<td>.95</td>
</tr>
<tr>
<td>Error C</td>
<td>197.55</td>
<td>45</td>
<td>4.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emb x Perf M</td>
<td>2.17</td>
<td>2</td>
<td>1.09</td>
<td>.06</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Age x Emb x PM</td>
<td>1.61</td>
<td>4</td>
<td>.40</td>
<td>.02</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Error BC</td>
<td>1633.88</td>
<td>90</td>
<td>18.15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
main effects (F=52.20, df=2,90 (emb); E=939.72, df=1,45 (PN); all p > .05). The only significant interaction was age x performance measures (F=5.86, df=2,45, p < .05). Mean scores for each age group on each measure are presented in Table 5. This finding however, again is trivial due to the differential ceilings on the two measures.

Binomial tests were employed to determine whether there was any age difference in ability to act out 2 clauses. Three year olds acted out 1 clause significantly more often than 2 clauses (z=3.08, p < .05), but both 4 and 5 year olds acted out 2 clauses significantly more often than 1 clause (z=13.5 (4 year olds); z=9.67 (5 year olds); all p < .05). (See Table 6.)

Order

Chi square tests were employed to determine whether age and ability to act out 2 clauses in the correct order were related. Overall ages there is a strong tendency to put 2 clauses in correct order, when 2 clauses are acted out (χ²=5.68, p < .05). (See Table 7) Age and ability to act clauses out in the correct order, however, were found to be independent (χ²=1.728, p > .05).

Since it is difficult to see if a child is using an order-of-mention strategy in center-embedded sentences, right and left-embedded sentences were analyzed separately. The results proved to be the same as when looking across all three sentence types. Overall ages there was a reliable tendency to choose correct order, when acting out 2 clauses, in both sentence types (χ²=9.81
Table 5
Mean scores for number of elements and transitions

<table>
<thead>
<tr>
<th></th>
<th># Elements</th>
<th># Transitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.E.</td>
<td>17.0</td>
<td>11.3</td>
</tr>
<tr>
<td>L.E.</td>
<td>17.5</td>
<td>11.5</td>
</tr>
<tr>
<td>C.E.</td>
<td>13.8</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td><strong>48.3</strong></td>
<td><strong>30.9</strong></td>
</tr>
<tr>
<td>4 Year Olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.E.</td>
<td>24.0</td>
<td>16.0</td>
</tr>
<tr>
<td>L.E.</td>
<td>23.5</td>
<td>15.5</td>
</tr>
<tr>
<td>C.E.</td>
<td>19.6</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td><strong>67.1</strong></td>
<td><strong>42.6</strong></td>
</tr>
<tr>
<td>5 Year Olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.E.</td>
<td>23.8</td>
<td>15.8</td>
</tr>
<tr>
<td>L.E.</td>
<td>24.0</td>
<td>16.0</td>
</tr>
<tr>
<td>C.E.</td>
<td><strong>20.25</strong></td>
<td><strong>11.8</strong></td>
</tr>
<tr>
<td></td>
<td><strong>68.05</strong></td>
<td><strong>43.6</strong></td>
</tr>
</tbody>
</table>
Table 6

Number of sentences with 1 clause vs 2 clauses acted out

<table>
<thead>
<tr>
<th>Age Group</th>
<th>1 clause</th>
<th>2 clauses</th>
<th>z-score</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Olds</td>
<td>105</td>
<td>64</td>
<td>3.08</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>59</td>
<td>151</td>
<td>13.5</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>22</td>
<td>150</td>
<td>9.67</td>
<td>&lt; .05</td>
</tr>
</tbody>
</table>
Table 7

sentences acted out with clauses in correct order

Overall Ages

<table>
<thead>
<tr>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>209</td>
<td>163</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 5.68, \quad p < .05 \]

At Each Age Level

<table>
<thead>
<tr>
<th>Age Level</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Olds</td>
<td>38</td>
<td>26</td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>89</td>
<td>62</td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>82</td>
<td>75</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 1.728, \quad p > .05 \]
(right); \(\chi^2 = 26.597\) (left); all \(p < .05\) (See Table 8). But age and ability to act clauses in the correct order are not dependent for either right or left embedded sentences \(\chi^2 = .294\) (right); \(\chi^2 = 3.76\) (left); all \(p > .05\)

Right and Left Embedded Sentences (Hypothesis 2)

A series of binomial tests were carried out to determine the clause upon which the children were focusing their attention, when acting out only one clause. With right embedded sentences 3 year olds acted out the main clause (i.e. the first clause), significantly more often than the subordinate clause \(z = 3.0, p < .05\) (See Table 9). All four and five year olds acted out both clauses.

With left embedded sentences the opposite result was obtained. Three year olds acted out the subordinate clause (i.e., the first clause) significantly more often than the main clause \(z = 3.13, p < .05\) (See Table 9). Again 4 and 5 year olds predominantly acted out 2 clauses. There were only 2 cases among the 4 year olds in which 2 clauses were not acted out. In these cases, there were 1 subordinate and 1 main clause acted out.

Center Embedded Sentences (Hypothesis 3)

With center embedded sentences children at all ages acted out the subordinate clause more often than the main clause \(z = 5.31\) (3 Yrs), \(p < .05\). Scores for four and five year olds were not computed since they chose the subordinate clause in all cases.
Table 8

Sentences acted out in correct order by age and embeddedness

R.E. Sentences

<table>
<thead>
<tr>
<th>Overall Ages</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>58</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>$\chi^2 = 9.81, p &lt; .05$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>By Age</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Yrs</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>4 Yrs</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>5 Yrs</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>$\chi^2 = .294, p &gt; .05$</td>
<td></td>
</tr>
</tbody>
</table>

L.E. Sentences

<table>
<thead>
<tr>
<th>Overall Ages</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>109</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>$\chi^2 = 26.597, p &lt; .05$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>By Ages</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Yrs</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td>4 Yrs</td>
<td>46</td>
<td>15</td>
</tr>
<tr>
<td>5 Yrs</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>$\chi^2 = 3.76, p &gt; .05$</td>
<td></td>
</tr>
</tbody>
</table>
Table 9

Number of sentences where only main or Subordinate clause acted out

<table>
<thead>
<tr>
<th></th>
<th>Main Clause</th>
<th>Subordinate Clause</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.E. Sentences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Year Olds</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>z=3.0 p &lt; .05</td>
<td></td>
</tr>
<tr>
<td>L.E. Sentences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Year Olds</td>
<td>17</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>z=3.13 p &lt; .05</td>
<td></td>
</tr>
<tr>
<td>C.E. Sentences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Year Olds</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>z=5.31 p &lt; .05</td>
<td></td>
</tr>
</tbody>
</table>
Strategy: First NVN or Other?

Binomial tests were carried out to investigate whether children were focusing on a first NVN strategy or some other strategy in center embedded sentences. Those cases in which there were no clauses acted out, but in which 3 or more elements were acted out correctly were considered. At all age levels (3, 4, 5) children acted out the first NVN sequence significantly more often than any other sequence ($z=3.2$ (3 Yrs); $z=4.06$ (4 Yrs); $z=3.36$ (5 Yrs); all $p<.05$) (See Table 10). It should be noted that since we were looking at those cases where no clauses were acted out, there are only four possible choices the child could make. The two sequences of $S_1V_1O_1$ and $S_2V_2O_2$ are eliminated since they are complete clauses. The four alternative choices are then $S_1V_1O_2$, $S_1V_2O_2$, $S_1V_1S_2$, and $O_1V_2O_2$. We are then testing against a hypothetical null distribution of .25 vs. .75. What is being tested is whether $S_1V_1O_2$ (i.e. first NVN) is chosen significantly more often than the other 3 possibilities. Those children who selected one of the other alternatives, did not seem to be picking any one of the sequences consistently.

To decide whether these children were in fact using a first NVN strategy or some other strategy that looks similar, center-embedded sentences again were analyzed separately. We observed whether the first NVN, main clause, or subordinate clause was acted out most often. In this case the first NVN was not acted out significantly more often than one of the other two alternatives ($F^2=2.89$, $p>.05$). In fact the subordinate clause was acted out
Table 10

Number of C.E. Sentences with no clauses acted out
First NVN vs other strategy

<table>
<thead>
<tr>
<th></th>
<th>First NVN</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Olds</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>z=3.2 p≤.05</td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>z=4.06 p≤.05</td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>z=3/36 p≤.05</td>
</tr>
</tbody>
</table>
significantly more often than either the main clause or the first NVN sequence (See Table 11).

**Temporal vs Causal (Hypothesis 4)**

Performance on temporal and causal sentences was compared in order to determine whether there was a significant difference in their likelihood of being acted out in correct order. Although there was a consistent trend for temporal sentences to be acted out in correct order proportionately more often than causal sentences, at no age level, nor overall ages was the difference statistically significant ($\chi^2 = 1.36$ (3 Yrs); $\chi^2 = 2.10$ (4 Yrs); $\chi^2 = 2.62$ (5 Yrs); $\chi^2 = 3.0$ (Overall ages), all $p > 0.05$) (See Table 12).

A chi square analysis was performed in order to test for a relationship between age and ability to act out temporal sentences in correct order. Again, these two factors were found to be independent ($\chi^2 = 1.752$, $p > 0.05$). Results for causal sentences were similar ($\chi^2 = 0.239$, $p > 0.05$) (See Table 13).

**Before vs After**

Sentences containing *before* vs those containing *after* were also compared. For 3, 4, and 5 year olds no differences were found in proportion acted out correctly ($\chi^2 = 0.363$ (3 Yrs); $\chi^2 = 1.17$ (4 Yrs); $\chi^2 = 0.478$ (5 Yrs), all $p > 0.05$) (See Table 14). For sentences containing *before* over the 3 age levels, age and ability to choose correct order were not dependent ($\chi^2 = 1.44$, $p > 0.05$).
Table 11
Center Embedded sentences
First NVN vs main vs subordinate

<table>
<thead>
<tr>
<th></th>
<th>First NVN</th>
<th>Main</th>
<th>Subordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Olds</td>
<td>12</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>10</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>5</td>
<td>1</td>
<td>34</td>
</tr>
</tbody>
</table>

$\chi^2 = 2.89$ p > .05
Table 12

Writer of sentences acted out in correct order, Temporal vs causal

<table>
<thead>
<tr>
<th>Overall Ages</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal</td>
<td>108</td>
<td>71</td>
</tr>
<tr>
<td>Causal</td>
<td>96</td>
<td>91</td>
</tr>
</tbody>
</table>

$\chi^2 = 3.002 \ p > .05$

At Each Age Level

<table>
<thead>
<tr>
<th></th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal 3 Yrs.</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Causal</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

$\chi^2 = 1.357 \ p > .05$

<table>
<thead>
<tr>
<th></th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal 4 Yrs.</td>
<td>48</td>
<td>26</td>
</tr>
<tr>
<td>Causal</td>
<td>41</td>
<td>36</td>
</tr>
</tbody>
</table>

$\chi^2 = 2.101 \ p > .05$

<table>
<thead>
<tr>
<th></th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal 5 Yrs.</td>
<td>41</td>
<td>34</td>
</tr>
<tr>
<td>Causal</td>
<td>41</td>
<td>40</td>
</tr>
</tbody>
</table>

$\chi^2 = .257 \ p > .05$
Table 13

Number of sentences acted out in correct order
Temporal and causal sentences

### Temporal Sentences

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Olds</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>48</td>
<td>26</td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>41</td>
<td>34</td>
</tr>
</tbody>
</table>

$\chi^2 = 1.75 \quad p > .05$

### Causal Sentences

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Correct Order</th>
<th>Incorrect Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Olds</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>41</td>
<td>36</td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>41</td>
<td>40</td>
</tr>
</tbody>
</table>

$\chi^2 = .239 \quad p > .05$
Table 14
Number of sentences acted out in correct order
Before and After

<table>
<thead>
<tr>
<th></th>
<th>Correct Order</th>
<th>Incorrect Order</th>
<th>( \chi^2 )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before vs After</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Yrs.</td>
<td>Before</td>
<td>13</td>
<td>6</td>
<td>5 ( \chi^2 = 3.63 ) ( p &gt; .05 )</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Yrs.</td>
<td>Before</td>
<td>22</td>
<td>13</td>
<td>13 ( \chi^2 = 1.17 ) ( p &gt; .05 )</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>25</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>5 Yrs.</td>
<td>Before</td>
<td>19</td>
<td>19</td>
<td>19 ( \chi^2 = 4.78 ) ( p &gt; .05 )</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>22</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>After</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Year Olds</td>
<td>13</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>26</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>22</td>
<td>16</td>
<td>16 ( \chi^2 = 1.26 ) ( p &gt; .05 )</td>
<td></td>
</tr>
<tr>
<td><strong>Before</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Year Olds</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Year Olds</td>
<td>22</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Year Olds</td>
<td>19</td>
<td>19</td>
<td>19 ( \chi^2 = 1.44 ) ( p &gt; .05 )</td>
<td></td>
</tr>
</tbody>
</table>
The same was true for sentences containing after (t = 1.26 p > .05) (See Table 14).

**Imitation Task (Memory)**

To test whether the number of words remembered was significantly less than 7, t tests were applied to the imitation task data. Analyses indicated 3 year olds remembered an average of 7 words per sentence. Both 4 and 5 year olds remembered significantly more than 7 words per sentence (t = .430, p > .05 (3 Yrs); t = 9.35, p < .05 (4 Yrs); t = 1490, p < .05 (5 Yrs).

Next, the data on the number of elements and transitions remembered were analyzed by means of t tests to determine whether there were any significant differences in the number remembered in the comprehension task vs the imitation task. For both 3 and 4 year olds there were significantly more elements remembered in the imitation task than in the comprehension task (t = 4.42 (3 Yrs); t = 2.21 (4 Yrs); all p < .05). Among the 5 year olds there were no significant differences in the number remembered (t = .585, p > .05). For the number of transitions remembered, there were no significant differences in the number remembered at any of the 3 age levels (t = .490 (3 Yrs); t = 1.234 (4 Yrs); t = 1.031 (5 Yrs); all p > .05).
CHAPTER IV
DISCUSSION

The aim of the present study was to determine how young children comprehend complex sentences. All the major hypotheses were supported to some degree by the data.

As was hypothesized, children did appear to use a first noun-verb-noun strategy. With both right and left-embedded sentences, it was expected that the first clause (i.e. first N+V+N) would be acted out more often. With right-embedded sentences, 3 year olds acted out the main clause (i.e. the first clause) significantly more often than the subordinate clause. Three year olds also acted out the subordinate clause (i.e. first clause) significantly more often than the main clause, in left-embedded sentences. All 4 and 5 year olds acted out two clauses with right embedded sentences. With left embedded sentences, all 5 year olds acted out two clauses, and there were only two cases among the 4 year olds where two clauses were not acted out. With center embedded sentences it was hypothesized that 3 year olds would have difficulty acting out either clause. Results indicated that this was not the case. Three year olds were indeed able to act out one clause, and in most cases it was the subordinate clause. Four and 5 year olds acted out the subordinate clause significantly more often than any other sequence also. When no clauses, but at least three elements, were acted out the sequence acted out significantly more often was the first noun, the first verb, and the nearest following noun. This was the
case in all three age groups, however, the subordinate clause was acted out significantly more often than any other sequence across all ages, when there was a clause acted out.

These hypotheses are related in that they are examining whether children are using a first NV(N) strategy to comprehend complex sentences. The center-embedded sentences allowed us to further clarify this question by using an interrupted structure. Bever stated that young children select the first NV(N) sequence and label it as actor-action-object of the main clause. That is, younger children would act upon the first clause in a complex sentence. The results of the present study support Bever's notion. Young children do appear to be dependent on the first NV(N) strategy. Bever suggested that this strategy tended to be overgeneralized around the age of four. The results lend some support to Bever's position, since both 3 and 4 year olds acted out the first NV(N) sequence significantly more often than any other sequence.

The analysis of center-embedded sentences yielded some interesting results. It would appear that if a child is simply comprehending a few specific elements, he focuses on the first NV(N) sequence. However, the majority of the children in this study were able to act out one clause, the subordinate clause. It would appear then that young children do rely on Bever's Strategy B, unless they are called upon to comprehend a sentence in which the first clause is interrupted, as is the case with center-embedded sentences. What they do in these instances is
to act upon the first 'complete' clause, which in center-embedded sentences is the subordinate clause.

Both Brown (1971) and Lahey (1974) found that 3 year olds had more difficulty with right-embedded sentences than center-embedded sentences. The results of the present study appear to be in contradiction to those of Brown and Lahey. However, a closer look at the sequences involved in the sentences is revealing. In the previous authors' right-embedded sentences, the referent of the relative clause is ambiguous, since both nouns precede the subordinate clause. Center-embedded sentences in the present study may be similarly ambiguous, since both subjects precede the two verbs. The results then may not really be discrepant.

Slobin (1978) has suggested some very specific language processing strategies that children use, one of which may offer an explanation as to why children in the present study found center-embedded sentences much more difficult to comprehend than right or left-embedded sentences. This strategy which Slobin labels "Operating Principle D", states that the child avoids interruptions or rearrangements of linguistic units. Slobin states that the greater the separation between related parts of a sentence, the greater is the tendency that the sentence will not be adequately processed (in imitation, comprehension, or production). This strategy may account for the results pertaining to center-embedded sentences. Due to the interruption in the main clause, the sentence was inadequately
processed. Either simply the first NV(N) sequence was processed or only the subordinate clause.

Children in all age groups selected the subordinate clause in both left and center-embedded sentences. This tends to contradict what Townsend and Erb stated. In their study, they concluded that young children will simply interpret the main clause, when they encounter a sentence which is difficult for them to comprehend. Although the authors do acknowledge that they may be focusing on the 'first' clause, they do say this is due to the fact they have learned that the second clause contains less important information. The implication however is that young children are able to judge whether a clause is main or subordinate, and know that the main clause has more important properties. From these authors' findings one would expect that a young child would be able to choose the main clause regardless of the order in which the two clauses were presented in the sentence. The results of the present study however, did not support this idea. Children in the present study selected the main clause in right embedded-sentences, but they appeared to be simply focusing on the 'first' clause. This was evident when they were asked to act out left and center-embedded sentences. In these cases, the subordinate clause was selected. One must assume then, that these children cannot distinguish between main and subordinate clauses, and are simply focusing on the word order of a sentence.

As was hypothesized, there was a significant improvement
with age in the ability to act out complex sentences containing main and subordinate clauses. Significantly more 4 and 5 year olds than 3 year olds acted out two clauses. This increase in ability is evident across all three sentence types: right, left and center-embedded. With right and left embedded sentences there were only 59 cases (of a possible 128) where both clauses were acted out by 3 year olds. In contrast, among 4 and 5 year olds, there were only two cases where children failed to act out both clauses. With center-embedded sentences, there were many more 5 year olds acting out two clauses than there were 3 year olds. However, there were considerably more 5 year olds acting out only one clause than with right and left-embedded sentences. There were only 5 cases (of a possible 64) in the 3 year old group acting out two clauses, as opposed to 25 cases among the 4 year olds, and 30 among the 5 year olds.

It was also expected that the ability to act out clauses in the correct order and age would be dependent. This turned out not to be the case. There was however a definite tendency to act out clauses in the correct order, when two clauses were acted out. As noted above, however, the ability to act out two clauses increases with age. So it would appear that, when a child is able to act out two clauses, he will be able to act them out in correct order.

The results of H.D. Brown's study (1971) showed a significant main effect for age. He suggested the ability to comprehend complex sentences develops between the ages of 3 and 5. As in
In the present study, Brown also found no significant difference between 4 and 5 year olds. Brown stated that with relativized structures, children reach a point around 4 years of age, where development levels off, with little increase in the next year. It appears that the same is true for non-relativized complex sentences. There was very little difference between 4 and 5 year olds, but considerable difference between 3 and 5 year olds in the present study. It may be that the 5 year olds had no room to show their increased ability. If they were given sentences with a greater degree of complexity, it might allow for larger differences between 4 and 5 year olds.

Since there had been very little study comparing temporal—and causal complex sentences, analyses were conducted to determine which conjunctions were easier to comprehend. Amidon and Carey found the difference on children's comprehension of sentences containing before and after was not significant. Bebout et al. (1978) found similar results on children's comprehension of sentences containing different causal conjunctions. The difference again was not significant. It was expected that causal sentences would be more difficult for children to understand than temporal sentences, since 6 to 7 year olds (in Bebout et al study) were still having difficulty with causal complex sentences. As was found in the Amidon and Carey (1972) study, the difference between children's comprehension of sentences containing before and after was not significant. Children tended to be able to put clauses in the correct order, if they acted out two clauses, in either of these types of sentences. Results indicated that neither
temporal nor causal complex sentences were easier, for any of the three types of embeddings, or at any of the three age levels. Results tended to support Amidon and Carey's statement that difficulty was experienced not because the sentence was temporal or causal in nature, but because the sentence contained a subordinate clause, and because of the location of that subordinate clause. The Bebout et al study indicated that the degree of complexity (i.e. positioning of the subordinate clause) is the main factor in determining the child's difficulty in comprehending a complex structure.

It has been suggested that sufficient storage space in memory may play an important role, in the child's ability to comprehend complex sentences. Results from the imitation task indicated that failure to comprehend cannot be simply attributed to inadequate storage space, at least for the present data. Three year olds remembered at least seven words, and both four and five year olds remembered more than seven words per sentence. Thus they should be able to store NVN, NVN, and the conjunction. More elements were remembered in the imitation task than in the comprehension task by three and four year olds. The difference between the numbers remembered in the five year old group was not significant. At all age levels, the difference was not significant for the number of transitions remembered in the two tasks. Therefore, one can conclude that these children had enough slots in memory storage to enable them to remember two clauses.
The present study has several limitations. The sentence structure of some of the test sentences was very awkward (e.g., center-embedded sentences). These constructions, where one clause is interrupted by another clause, would not be encountered in the language the child hears everyday. It is possible that familiarity with a particular sentence type will aid the child in comprehending such structures. Lack of familiarity with center-embedded structures may be a factor in the difficulty children have comprehending them.

Another possible limitation may be due to the procedure of placing all the toys on the table in front of the child. It was noted that in some cases, that one particular toy would attract the child's attention, and prove to be a distraction. However, the alternative of placing only the four toys needed on the table, and keeping all other toys out of sight, might provide extra linguistic cues to comprehension.

The population of children chosen for this study may not be representative of children in general. All children were selected from two nursery schools. Being involved in an enriched environment such as this, may result in a child developing linguistic abilities much earlier than children who do not attend nursery school.
SUMMARY

In summary, the ability to comprehend complex sentences seems to develop between the ages of three and five. Younger children (3 year olds) are not as competent in comprehending complex sentences as are older children (5 year olds). The present results suggest that this is due to a partial reliance on Bever's Strategy B in that the first noun-verb-noun sequence is selected as the subject-verb-object (i.e. main clause) regardless of the fact that it may be a subordinate clause. As children develop in language, they are able to use Strategy B to its fullest, and can recognize a subordinate clause. Results tend to support Bever's arguments regarding the sequential adoption of strategies to comprehend sentences. In general surface structure properties appear to be more important than properties on any other level in young children's attempts at comprehension of complex sentences.
APPENDIX

Lists of Sentence Presentations
LIST A(1)

Comprehension Task:

1. The car hit the tree, before the truck ran over the ball. (R.E.)
2. Because the girl pulled the wagon, the boy rode his bike. (L.E.)
3. The man looked for the hammer, after the lady found the key. (R.E.)
4. The boy, after the little girl carried the cup, threw the ball. (C.E.)
5. The truck, before the tractor pushed the car, pulled the wagon. (C.E.)
6. Before the man opened the box, the lady closed the door. (L.E.)
7. The dog chewed the sock, because the cat played with the ball. (R.E.)
8. Because the dog ran around the room, the baby crawled to mommy. (L.E.)
9. The boy, because the girl sat on the truck, washed the car. (C.E.)
10. After her father sat down on the chair, the girl played with the dog. (R.E.)
11. The horse chewed the shoe, because the cow kicked the pail. (L.E.)
12. The girl, because her mother picked up the doll, carried the purse. (C.E.)

Imitation Task:

1. The dog, because the cat played with the ball, chewed the sock. (C.E.)
2. The black and white tom cat drank the small bowl of milk.
3. Because her mother picked up the doll, the girl carried the purse. (L.E.)
4. The car, before the truck ran over the ball, hit the tree. (C.E.)
5. The brown-and-white farm dog chased the big flock of sheep.
6. The boy rode his bike, because the girl pulled the wagon. (R.E.)
7. Before the tractor pushed the car, the truck pulled the wagon. (L.E.)
8. The girl played with the dog, after her father sat down on the chair. (R.E.)
LIST A(2)

Comprehension Task:

1. Before the man opened the box, the lady closed the door. (L.E.)
2. The boy, because the girl sat on the truck washed the car. (C.E.)
3. After her father sat down on the chair, the girl played with the dog. (L.E.)
4. The horse chewed the shoe, because the cow kicked the pail. (R.E.)
5. Because the girl pulled the wagon, the boy rode his bike. (L.E.)
6. The truck, before the tractor pushed the car, pulled the wagon. (C.E.)
7. The dog chewed the sock, because the cat played with the ball. (R.E.)
8. The man looked for the hammer, after the lady found the key. (R.E.)
9. The car hit the tree, before the truck ran over the ball. (R.E.)
10. Because the dog ran around the room, the baby crawled to mommy. (L.E.)
11. The boy, after the little girl carried the cup, threw the ball. (C.E.)
12. The girl, because her mother picked up the doll, carried the purse. (C.E.)

Imitation Task:

1. Before the tractor pushed the car, the truck pulled the wagon. (L.E.)
2. The girl played with the dog, after her father sat down in the chair. (R.E.)
3. The car, before the truck ran over the ball, hit the tree. (C.E.)
4. The black and white tom cat drank the small bowl of milk.
5. The dog, because the cat played with the ball, chewed the sock. (C.E.)
6. Because her mother picked up the doll, the girl carried the purse. (L.E.)
7. The boy rode his bike, because the girl pulled the wagon. (R.E.)
8. The brown and white farm dog chased the big flock of sheep.
LIST B(1)

Comprehension Task:

1. The boy rode his bike, because the girl pulled the wagon. (R.E.)
2. After the little girl carried the cup, the boy threw the ball. (L.E.)
3. The lady closed the door, before the man opened the box. (R.E.)
4. Because the girl sat on the truck, the boy washed the car. (L.E.)
5. The horse, because the cow kicked the pail, chewed the shoe. (C.E.)
6. Before the tractor pushed the car, the truck pulled the wagon. (L.E.)
7. The man, after the lady found the key, looked for the hammer. (C.E.)
8. The baby crawled to mommy, because the dog ran around the room. (R.E.)
9. The dog, because the cat played with the ball, chewed the sock. (C.E.)
10. The car, before the truck ran over the ball, hit the tree. (C.E.)
11. The girl played with the dog, after her father sat down on the chair. (R.E.)
12. Because her mother picked up the doll, the girl carried the purse. (L.E.)

Imitation Task:

1. The truck, before the tractor pushed the car, pulled the wagon. (C.E.)
2. After her father sat down on the chair, the girl played with the dog. (L.E.)
3. The girl, because her mother picked up the doll, carried the purse. (C.E.)
4. The car hit the tree, before the truck ran over the ball. (R.E)
5. Because the girl pulled the wagon, the boy rode his bike. (L.E.)
6. The black and white tom cat drank the small bowl of milk.
7. The brown and white farm dog chased the big flock of sheep.
8. The dog chewed the sock because the cat played with the ball. (R.E.)
Comprehension Task:

1. Before the tractor pushed the car, the truck pulled the wagon. (L.E.)
2. The boy rode his bike, because the girl pulled the wagon. (R.E.)
3. The dog, because the cat played with the ball, chewed the sock. (C.E.)
4. The horse, because the cow kicked the pail, chewed the hoe. (C.E.)
5. After the little girl carried the cup, the boy threw the ball. (L.E.)
6. The baby crawled to mommy, because the dog ran around the room. (R.E.)
7. The man, after the lady found the key looked for the hammer. (C.E.)
8. Because her mother picked up the doll, the girl carried the purse. (L.E.)
9. The car before the truck ran over the ball, hit the tree. (C.E.)
10. Because the girl sat on the truck, the boy washed the car. (L.E.)
11. The girl played with the dog, after her father sat down on the chair. (R.E.)
12. The lady closed the door, before the man opened the box. (R.E.)

Imitation Task:

1. The dog chewed the sock, because the cat played with the ball. (R.E.)
2. The brown and white farm dog chased the big flock of sheep.
3. The truck, before the tractor pushed the car, pulled the wagon. (C.E.)
4. Because the girl pulled the wagon, the boy rode his bike. (L.E.)
5. The girl, because her mother picked up the doll, carried the purse. (C.E.)
6. The car hit the tree, before the truck ran over the ball. (R.E.)
7. After her father sat down on the chair, the girl played with the dog. (L.E.)
8. The black and white tom cat drank the small bowl of milk.
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Clark, E.V., "On the Acquisition of the Meaning of Before and After". Journal of Verbal Learning and Verbal Behaviour, 1971, 10, 266-275


VITA AUCTORIS

Marilyn Kinnax was born in Cambridge, Ontario to Ralph and Margaret Mary Oxley on January 12, 1954. She was educated in Cambridge and graduated from Glenview Park Secondary School in 1972. She graduated with a three year B.A. in psychology from Alford Laurier University, Waterloo, Ontario, in 1975. After completing one year at McGill University, Montreal, Quebec, she entered the M.A. program at the University of Windsor, Windsor, Ontario. In 1978 she received her M.A. in Developmental Psychology.