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Immediate Memory for Words from Main and Subordinate Clauses at Different Age Levels

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A probe-latency task was used to assess accessibility to the words from the first and second clauses of four types of sentences. The sentences contained either independent clauses or main and subordinate clauses. The subjects were 3-, 4-, and 5-year-old children, and adults. On sentences with no main-subordinate distinction, word recognition latencies were shorter for second clauses for all groups except 4-year-olds. On sentences with main and subordinate clauses systematically varied over position in the sentence, however, latencies were most often shorter for subordinate clauses, even when they occurred at the beginning of the sentence. The results indicate that a clause is not simply represented in abstract form rather than verbatim form once the complete clause has been heard, but instead the structural role of the clause, as well as other factors, influences accessibility to verbatim form. It is proposed that listeners frequently interpret an asserted main clause more readily than a subordinate clause. This comprehension strategy appears in different forms at different stages of development.

INTRODUCTION

Studies of sentence comprehension have indicated that the listener segments speech into clauses (e.g., Garrett *et al.*, 1966) and "erases" the verbatim form of a clause from active memory (e.g., Jarvella, 1971). The present study is

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concerned with how the erasure process develops and how it is affected by structural differences between clauses.

Once clause segmentation occurs, the listener is less likely to have clause information in verbatim form. This is indicated by probe-latency experiments which have shown that listeners take longer to recognize a word from the first ("previously heard") clause of a sentence than from the second ("immediate") clause (Caplan, 1972; Shedletsky, 1974). The difference in latencies to words from first and second clauses cannot be attributed to ordinal position of the target word in the sentence, since the clause position effect is obtained when ordinal position of the target in the sentence is controlled (Caplan, 1972). The listener apparently analyzes one clause at a time; when this analysis is complete, information from the clause is stored in a form more abstract than the actual words in the clause.

Caplan's (1972) experiments, however, confounded the position and structural roles of the clause. Other research suggests that the structural role of the clause affects the listener's representation of the clause independently from the position of the clause. Smith and McMahon (1970) presented questions such as "What happened first?" followed by a sentence containing clauses related by *before* or *after* (hereafter a "temporal" sentence). Subjects responded faster when the answer was in the main clause, whether the main clause was in first or second position. Thus listeners apparently obtain the meaning of a main clause more readily than they do the meaning of a subordinate clause. In a probe-latency experiment Shedletsky (1974) found different effects of ordinal position of the target word in main vs. adverbial-subordinate clauses in both clause positions: early targets were recognized faster than late targets in subordinate clauses, but late targets were recognized faster in main clauses. The earlier interpretation of the main clause may be responsible for the different search patterns for main and subordinate clauses: listeners may use some type of parallel search on the meaningful representation of the main clause but may search the verbatim form of subordinate clause by a serial self-terminating search.

Children may also have better access to main clause meaning than to subordinate clause meaning. Townsend (1974) and Townsend and Erb (1975) found that 3- and 4-year-old children's errors to comparative questions such as "Who has more apples than he has oranges?" indicate that they frequently interpret the question as "Who has more apples?" These results may indicate that the meaning of the main clause is more accessible than the meaning of the subordinate clause, since linguistic analyses generally consider the first clause of a comparative sentence to be the matrix clause in underlying

structure (e.g., Chomsky, 1965), or they may indicate that the meaning of the first clause is more accessible than the meaning of the second clause.

Amidon and Carey (1972) found that when 5-year-old children are asked to act out the events of two-clause temporal sentences, their errors most often consist of an omission of the subordinate clause event whether it occurs in the first clause position or the second clause position. This result, however, has been obtained only when the temporal sentence is presented in the form of a command; it has not been obtained, at least with younger children, when the temporal sentence is presented as a declarative (Clark, 1971; Johnson, 1975).

Other research indicates that reliance on the listening strategy of interpreting the main clause first may change during development and that this listening strategy may interact with other strategies. Bever (1970*a,b*) presented data to support his proposal that listeners of all ages organize temporal sentences around the first event but that children of different ages combine this strategy with one based on clause structure or clause position: 2- and 3-year-old children performed better at acting out temporal sentences when the first event was in the main clause, as in *before* sentences; 4-year-old children, however, performed better when the first event was in the first clause, as in *before* sentences with the main clause first and *after* sentences with the main clause second. Although there is the possibility of a strategy of organizing the clauses of temporal sentences around the clause containing the first event (see also Clark, 1971; Clark and Clark, 1968), Bever's results show that this strategy may interact with structural and order strategies at different ages. The 2- and 3-year-olds expect the first event to be in the main clause, but 4-year-olds expect the first event to be in the first clause.

These studies have demonstrated that main clauses are interpreted more readily than subordinate clauses in several different sentence types, although age, sentence form, and other listening strategies may influence the priority of the main clause in comprehension. The general priority of the main clause in comprehension may be due to the structural "dominance" of the main clause (Kornfeld, 1973; Amidon and Carey, 1972; Smith and McMahon, 1970), or it may be due to the fact that the main clause generally contains the asserted or "new" information of the sentence (Bever, 1970*b*). Under the former view (Kornfeld, 1973), the listener reconstructs the deep structure representation of the sentence from the top down; since the main clause is "higher" in the tree, it dominates the subordinate clause and is interpreted sooner. Under the latter view, the listener postpones interpreting the given or presupposed information in a subordinate clause in favor of interpreting the new information in the

main clause. After the sentence as a whole has been interpreted, the listener may use the given information as a cue for indicating where the new information should be stored in long-term memory (Clark and Haviland, 1974; Haviland and Clark, 1974). It is difficult to determine whether the main clause or the asserted information is prior in the listener's initial interpretation of the sentence, since the main clause often contains the asserted information. However, if the Townsend (1974) and Townsend and Erb (1975) results on comprehension of comparative questions reflect a genuine comprehension strategy, the structural view would be favored since questions do not contain assertions.

The present study examined the generality of the strategy for interpreting the asserted main clause first in a variety of two-clause sentence types and at several age levels by determining the listener's accessibility to words from different clauses. Subjects indicated as quickly as possible whether a probe word was present or not in a sentence just heard. Probes for one of the two verbs were given after two-clause coordinate, comparative, relative, and temporal sentences. Coordinate sentences contained two independent clauses, comparative sentences contained a subordinate clause after the main clause, relative sentences contained a subordinate clause either after the main clause or embedded within it, and temporal sentences, using only the subordinating word *after,* contained a subordinate clause either before or after the main clause. Following Caplan (1972) it is assumed that a relatively long latency for recognition of a probe contained in a clause reflects the representation of that clause in terms of its meaning and the representation of the other clause in terms of its verbatim form.

If listeners represent a clause in terms of abstract meaning once the complete clause has been heard (Caplan, 1972), latencies for word recognition should be longer to first clause probes regardless of sentence type. On the other hand, if listeners postpone interpretation of the subordinate clause until after the main clause has been interpreted, latencies should be longer to main clause probes in comparative, relative, and temporal sentences regardless of the position of the main clause in the sentence. If children show the shift in listening strategies proposed by Bever (1970*b*), 3- and 5-year-old children should show longer latencies to main clause probes but 4-year-olds should show no difference in latencies to main and subordinate clause probes. In addition, 3- and 5-year-olds should show a difference in latencies to main clause first and main clause second sentences, but the position of the main clause should have little effect on 4-year-olds' latencies.

METHOD

Subjects

The subjects were twelve 3-year-old (mean age 3 years 6 months, seven males), twelve 4-year-old (mean age 4;7, five males), and twelve 5-year-old (mean age 5;6, six males) volunteers from Passaic Day Care Center, Passaic, New Jersey, and twelve adult (four males) volunteers from Montclair State College, Montclair, New Jersey.

Materials

Twelve lexical contents consisting of noun-verb-noun-verb-noun sequences were constructed. The last noun was always a two-syllable word, whereas the other nouns and verbs were one-syllable words. Only words judged to be familiar to young children were used. The 12 lexical contents were arranged in a single random order. The 12 lexical contents were converted into sentences by adding articles *(the),* clause connectives *(and, faster than, after, that),* and a pronominalized form *(he, that)* of either the first or the second noun. The six sentence types were initially arranged in the following random order: temporal main second, comparative, temporal main first, relative main first, relative main second, and coordinate. The position of each sentence type in the list was then counterbalanced, giving six orders of sentence types. Six tape recordings were made of the 12 lexical contents in the six orders of sentence types, the second half of each recording of lexical contents containing the same ordering of sentence types as the first half. The following examples illustrate the six sentence types using one lexical content:

S1. Coordinate: *The owl scratched the fox and he touched the monkey.*
S2. Comparative: *The owl scratched the fox faster than he touched the monkey.*
S3. Temporal, main verb first: *The owl scratched the fox after he touched the monkey.*
S4. Temporal, main verb second: *After the owl scratched the fox he touched the monkey.*
S5. Relative, main verb first: *The owl scratched the fox that touched the monkey.*
S6. Relative, main verb second: *The owl that scratched the fox touched the monkey.*

Recordings of the 24 verbs in the lexical contents were made on a second channel. One of the verbs for a lexical content was spliced onto the tape one sec (7½ inches or 19.05 cm of tape) after the end of the sentence. The ordering of first vs. second verb as the probe word was randomly determined, with the provisions that neither position was probed more than two times consecutively, that each half of the list contained an equal number of first and second verb probes, and that each of the six sentence types had both positions probed once in each of the six recordings. Six additonal tapes were constructed from the six original tapes by reversing the verb probed in each lexical content.

Six filler sentences were constructed from lexical contents similar to those of the test sentences. Each sentence type was represented in the filler sentences. Two of the fillers were placed at the beginning of each type of test sentences, and two were placed in each half of each tape of test sentences such that there were never more than three consecutive test sentences. The second filler sentence in the list was followed by a verb probe which was contained in the sentence; the remaining five filler sentences were followed by verb probes not contained in the sentence.

Procedure

The subjects were tested individually. The subject was told that he would hear a sentence out of one speaker and a word out of a second speaker. The subject was instructed to say as quickly as possible whether the word was in the sentence ("yes") or not ("no"), and to repeat the sentence. A Hunter millisecond timer was automatically started by the probe word and was stopped by the subject's response. Each subject heard only one of the 12 tapes; each tape consisted of 12 test sentences and six filler sentences.

Before the experiment started, the 3-year-old subjects required some instruction on the procedure. These subjects were first asked to repeat a simple sentence such as "The cow jumped over the moon," and then were given two sentences such as "The cow jumped over the moon" and "The dish ran away with the spoon," followed by the questions "Did I say cow (fork)?" The 3-year-olds were then able to perform in the experiment with the procedure used with other subjects.

RESULTS

Although the data of primary interest were reaction times (RTs) to probes which were contained in the sentence, two additional types of data,

sentence recall and probe recognition errors, were obtained. Subjects were asked to recall the sentence to ensure attention to the sentence. While there were recall errors, the errors maintained the sense of the sentence. These data were taken to indicate that the subjects understood the sentences; therefore, the recall data were not analyzed further. The probe recognition error rate for sentences which contained the probe was 2.6%, while the error rate for sentences which did not contain the probe was 1.6%. The recognition errors were so infrequent that their distributions revealed no significant trends other than that they were slightly more frequent at the lower age levels.

Since probe recognition errors were so rare, RTs for all sentences containing the probe were used in the statistical analysis. Because each subject within an age group received particular combinations of sentence type, clause structure, and verb position with different lexical materials (see Method), the reported statistical tests indicate the generality of the results over both subjects and materials (see Clark, 1973, p. 348). The results indicate three general trends. The 4-year-olds generally responded faster to probes of the first verb; other groups more often responded faster to second verb probes. Second, the 4-year-olds did not respond faster to main clause first sentences, whereas other groups generally did. Third, all groups except 3-year-olds generally responded faster to subordinate verbs. Mean RTs for each of the two verb probes in the six sentence types are shown in Table I.

Coordinate and Comparative Sentences

Since coordinate sentences contain no subordinate clause, any differences in RT between clauses will be due solely to the effects of clause position. As shown in Table I, all age groups except the 4-year-olds responded more quickly to the second verb than to the first. RTs to coordinate sentences interacted with verb position and age, $F\,(3, 44) = 42.24$, $p < 0.001$. The source of this interaction was the faster RTs to first clause verbs for 4-year-olds, $F\,(1, 44) = 68.77$, $p < 0.001$, but the faster RTs to second clause verbs for all other groups, $F\,(1, 44) = 37.4$, $p < 0.001$. Thus, in the absence of any structural difference between clauses, 4-year-olds respond faster to the previously heard clause of a sentence whereas all other age groups respond faster to the clause just heard.

Comparative sentences have a main-subordinate distinction between clauses, but the main clause ordinarily occurs before the subordinate clause. Any differences in RT between clauses may therefore be due either to the effects of clause position or to the effects of clause structure. RTs for comparative sentences were faster for the first verb than for the second verb

Table I. Mean RTs (sec) for Recognition of Each Verb in Coordinate, Comparative, Temporal, and Relative Sentences

	Coordinate (S1)	Comparative (S2)	Temporal		Relative	
	Position probed	Position probed	Main 1st (S3) Position probed	Main 2nd (S4) Position probed	Main 1st (S5) Position probed	Main 2nd (S6) Position probed
Age group	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd
3 years	3.51 2.71	2.24 2.40	2.23 2.27	2.89 2.88	2.29 2.65	3.29 2.18
Sentence $\bar{X}$	3.11	2.32	2.25	2.89	2.47	2.74
4 years	1.97 2.88	1.27 3.04	2.10 1.87	1.73 2.09	1.98 1.86	1.68 2.17
Sentence $\bar{X}$	2.43	2.16	1.99	1.91	1.92	1.93
5 years	1.62 1.44	1.61 1.75	1.51 1.37	1.56 1.79	2.00 0.95	1.38 1.46
Sentence $\bar{X}$	1.53	1.68	1.44	1.68	1.48	1.42
Adults	1.23 1.04	1.24 1.33	1.13 0.96	1.19 1.40	1.20 0.95	1.37 1.05
Sentence $\bar{X}$	1.14	1.29	1.05	1.30	1.08	1.22

at all age levels, F (1, 44) = 583.8, $p < 0.001$. As with coordinate sentences, however, RTs to comparative sentences interacted with verb position and age, F (3, 44) = 337.1, $p < 0.001$. The source of this interaction was again due to a difference between 4-year-olds and other groups: the first verb-second verb difference for 4-year-olds differed from the average first verb-second verb difference for all other groups combined, F (1, 44) = 2019.3, $p < 0.001$. The 4-year-olds' larger first verb-second verb difference on comparatives distinguishes them from other groups in just the same way as on coordinate sentences: the words of the previously heard clause of a sentence are much more accessible for 4-year-olds than for other age groups.

Temporal and Relative Sentences

In temporal and relative sentences, the main verb occurs either before or after the subordinate verb. RTs to verbs in these sentences can therefore indicate any effect which clause structure might have on the tendency to recode a clause once the complete clause has been heard. Table II presents the mean RTs for the temporal and relative sentences for each age group as a function of the position and structural role of the verb in the sentence. Except for the main effect of sentence type and the interaction of sentence type with age, all main and interaction effects were significant at $p = 0.05$ or less. These interactions indicate three general trends. First, in relative sentences the 4-year-olds responded faster to first verbs whereas all other groups responded faster to second verbs; however, there was no effect of verb position in temporal sentences at any age level. Second, the 3-year-olds responded faster to main verbs in relative sentences and showed no main-subordinate difference in temporal sentences, whereas other groups generally responded faster to subordinate verbs in both temporal and relative sentences. Third, the 4-year-olds were the only group that did not respond faster to either temporal or relative sentences with the main verb in the first position.

RTs to first and second verbs interacted with age, F (3, 44) = 7.16, $p < 0.001$. This interaction was due to the 4-year-olds' faster RTs for first verbs than for second verbs over temporal and relative sentences combined, 1.87 vs. 2.00 sec, F (1, 44) = 5.07, $p < 0.05$, whereas RTs were faster to second verbs in all other age groups [3 years: 2.68 vs. 2.49, F (1, 44) = 10.83, $p < 0.01$; 5 years: 1.61 vs. 1.39 sec, F (1, 44) = 14.5, $p < 0.001$; adult: 1.22 vs. 1.09 sec, F (1, 44) = 5.07, $p < 0.05$]. However, RTs to first and second verbs at different age levels also interacted with sentence type, F (3, 44) = 6.71, $p < 0.001$. This interaction was due to a greater effect of verb position in relative sentences at all ages. Inspection of Table II reveals that in relative sentences,

Table II. Mean RTs (sec) for Recognition of Main, Subordinate, First, and Second Verbs in Temporal and Relative Sentences

	Temporal sentences				Relative sentences			
Age group	Main verb	Subordinate verb	1st verb	2nd verb	Main verb	Subordinate verb	1st verb	2nd verb
3 years	2.56	2.58	2.56	2.58	2.24	2.97	2.79	2.42
4 years	2.10	1.80	1.92	1.98	2.08	1.77	1.83	2.02
5 years	1.65	1.47	1.54	1.58	1.73	1.17	1.69	1.21
Adults	1.27	1.08	1.16	1.18	1.13	1.16	1.28	1.00

the 4-year-olds responded faster to first verbs and all other groups responded faster to second verbs. Verb position had no effect in temporal sentences for any age group.

RTs to main and subordinate verbs interacted with age, F (3, 44) = 39.98, $p < 0.01$. This interaction was due to 3-year-olds' faster RTs for main verbs than for subordinate verbs over temporal and relative sentences combined, 2.39 vs. 2.78 sec, F (1, 44) = 208.6, $p < 0.001$, whereas RTs were faster to subordinate verbs in all other groups [4 years: 2.08 vs. 1.78 sec, F (1, 44) = 123.4, $p < 0.001$; 5 years: 1.69 vs. 1.31 sec, F (1, 44) = 198.0, $p < 0.001$; adult: 1.20 vs. 1.12 sec, F (1, 44) = 8.78, $p < 0.01$]. However, RTs to main and subordinate verbs at different age levels also interacted with sentence type, F (3, 44) = 17.98, $p < 0.001$. Inspection of Table II reveals that the 3-year-olds were faster on main verbs only in relative sentences. Adults were faster on subordinate verbs only in temporal sentences, and 4- and 5-year-olds were consistently faster on subordinate verbs in both temporal and relative sentences. Thus the 3-year-olds overall responded faster to main verbs whereas other groups overall responded faster to subordinate verbs, but these effects were not found on both sentence types at all age levels.

RTs to main and subordinate verbs interacted with the position of the verb as well as with age and sentence type, F (3, 44) = 3.40, $p < 0.05$. The interaction of the structural role and position of the verb was due to the generally faster RTs to sentences with the verbs ordered as main-subordinate rather than as subordinate-main. All age groups except 4-year-olds showed at least some tendency to respond faster to sentences with the main verb in the first position (see Table I). The 3-year-olds showed the main first effect on both temporal sentences, F (1, 44) = 60.5, $p < 0.01$, and relative sentences, F (1, 44) = 10.5, $p < 0.01$. The 5-year-olds showed the main first effect only on temporal sentences, F (1, 44) = 8.28, $p < 0.01$. The adults showed the effect on temporal sentences, F(1, 44) = 9.38, $p < 0.01$, and somewhat on relative sentences, F (1,44) = 2.73, $p < 0.25$. In contrast, the 4-year-olds clearly did not respond faster to main first sentences. Thus, with the exception of 4-year-olds, words from sentences with the main verb first were generally more accessible than were words from sentences with the main verb second.

DISCUSSION

There were three major results. First, words from the second clause of a sentence were not always more accessible than words from the first clause; rather, the verbatim form of the subordinate clause was quite often more accessible than that of the main clause, regardless of the position of the main

and subordinate clause in the sentence. These results indicate that sentence comprehension does not proceed clause by clause, but that, among other strategies, semantic interpretation and erasure of verbatim form from active memory occur more quickly in an asserted main clause than in a subordinate clause. This conclusion follows from Caplan's (1972) assumption about the data obtained from the probe-latency technique. Second, the most accessible clause position generally differed for 4-year-olds as compared with other age groups. The 4-year-olds generally had better access to the verbatim form of the first clause of the sentence, and, unlike other groups, did not show differences in accessibility to sentences with the main-subordinate order vs. subordinate-main order. Thus 4-year-olds clearly differ from other groups in the comprehension strategies they use. Third, the 3-year-olds did not show better access to words from subordinate clauses, contrary to the hypothesis that they attempt analysis of an asserted main clause first. We tentatively propose the following *ad hoc* interpretation of the 3-year-olds' results: the 3-year-olds seek to analyze the main clause first, but because of relatively inefficient computational procedures this analysis is relatively incomplete at the time of the test. The discussion will consider evidence both for and against these conclusions from the specific sentence types in the order coordinate, relative and temporal, and comparative, and will end with a consideration of the differences between sentence types.

Coordinate Sentences: Effects of Clause Position

The results for coordinate sentences support the hypothesis that sentence comprehension occurs clause by clause (Caplan, 1972; Jarvella, 1971). All age groups except 4-year-olds produced shorter latencies to the second clause of coordinate sentences. The shorter latencies to the second clause indicate that the verbatim form is more accessible for the second clause than for the first clause, perhaps because the first clause has been represented in terms of its meaning. The 4-year-olds' shorter latencies to the first clause of coordinate sentences, however, indicate that they hold the verbatim form of the first clause in memory at the time they hear the probe. The extra attention which 4-year-olds devote to the first clause of coordinate sentences may be due to their belief that the most important information occurs first (Bever, 1970*a,b*). In any case, the adults' performance on coordinate sentences, which do not contain clauses with the main-subordinate distinction, support the view that they interpret sentences one clause at a time.

Relative and Temporal Sentences: Effects of Clause Structure

The results for adults on relative sentences also provide general support for the hypothesis that comprehension proceeds clause by clause in that word recognition was faster for the second clause than for the first clause. However, a simple clause-by-clause theory of comprehension cannot account for the adults' somewhat shorter latencies to relative sentences with the main clause at the beginning of the sentence, nor can it account for the children's differences in latencies to main and subordinate clauses in relative sentences. These results indicate that the structure of the clause modifies clause by clause analysis.

The results for temporal sentences clearly do not support the clause-by-clause hypothesis since there were no first clause-second clause differences in latencies at any age level. Instead, all age groups except the 3-year-olds responded faster to subordinate clause probes. This result could be interpreted in terms of a comprehension strategy based on the temporal order of the events conveyed by the sentence. Because the first event of temporal sentences containing the subordinating marker *after* is always in the subordinate clause, the shorter latencies to subordinate clause probes could be due to the listener's attempt to first identify the first event. On this view, the listener organizes the clauses in terms of their temporal order and searches for a target beginning with the first event. However, the use of such a strategy should also produce shorter latencies to those sentences in which the temporal order of events corresponds to the order of mention of the events in the sentence (i.e., sentences with the subordinate clause at the beginning) since these sentences should be easier to organize around the temporal order of events. Since all age groups except the 4-year-olds responded more quickly to sentences with the main clause at the beginning, the results cannot be due to the use of a comprehension strategy based on a temporal ordering of the events conveyed by the sentence.

The shorter latencies to subordinate clauses in temporal sentences may instead be due to incomplete comprehension and hence more complete verbatim representation of the less important information in the subordinate clause. This proposal is consistent with Smith and McMahon's (1970) result of longer latencies to questions about the subordinate clause of temporal sentences. When a representation of meaning is required for a response, subjects respond slowly to the subordinate clause; however, when a representation of the verbatim form is required, subjects respond quickly to the subordinate clause. The proposal that the relatively slow word-recognition times for a main clause are due to the meaningful representation of the clause

is also consistent with the results of nonsentential item-recognition studies which have shown that latencies increase when the memory and probe items are presented in different forms (Chase and Calfee, 1969) or when the subject must decide whether a probe word is a synonym of a word in the memory set (Burrows and Okada, 1973). Since these studies indicate that recognition latencies are longer when the form of the test item does not correspond to the form in which stored information is represented, they support the interpretation that the longer latencies to main clause probes are due to the representation of the main clause in nonverbatim form.

It was found that adults produced longer latencies to temporal and relative sentences with the main clause in the second position, confirming Kornfeld (1973). This result is apparently due to the larger load on active memory caused by the retention of the verbatim form of the subordinate clause. When a probe is presented after a main second sentence, latencies may be slower either because more words of the sentence are directly compared with the probe or because the process of comparing the words with the probe is disrupted by the large load on active memory. Sternberg's (1966) result that recognition latencies increase with nonlinguistic memory set size is consistent with both of these interpretations. However, previous results that show that comparison time per item is constant as set size increases (Sternberg, 1966) and that additional but irrelevant memory requirements do not affect item-recognition time (Darley *et al.*, 1972) indicate that the latter interpretation is implausible. Thus the longer latencies to main second sentences may be due to a greater number of comparisons which the listener makes between the probe and the items stored in memory when he is searching main second sentences. The greater number of probe-memory item comparisons in main second sentences may be due to the representation of these sentences in a more verbatim, unanalyzed form.

The hypothesis that the listener interprets a main clause more quickly than a subordinate clause explains previous results which show that sentences with the main clause at the beginning of the sentence are easier to comprehend (Foss and Lynch, 1969), perceive (Holmes, 1973), and recall over intermediate retention intervals (Clark and Clark, 1968; Hoosain, 1974), and it explains why main first sentences impose a smaller load on active memory (Foss and Lynch, 1969; Tanenhaus and Carroll, 1975). The proposal also predicts that immediate verbatim recall will be superior for subordinate first sentences (Jarvella and Herman, 1972), since by postponing interpretation of a subordinate clause in the first position the listener has a more complete verbatim representation of the sentence at the time of the test. Thus the strategy of obtaining an abstract representation of the main clause relatively

early accounts for differences in performance with main first and main second sentences. The clause-by-clause view of processing cannot explain these differences.

Relative and Temporal Sentences: Age Differences

The children's results for temporal and relative sentences showed some age-related differences. The most obvious differences were that, on relative sentences, as on coordinate sentences, the 4-year-olds were the only group that responded more quickly to first clause probes; they were also the only group that did not respond more quickly to either main first temporal sentences or main first relative sentences. In addition, the 3-year-olds were the only group which responded more quickly to main clause probes in relative sentences and they were the only group which did not respond more quickly to subordinate clause probes in temporal sentences. If two assumptions are valid, we tentatively propose that the results for temporal and relative sentences are partially, although not entirely, consistent with the hypothesis that listeners of all ages attempt a relatively early interpretation of asserted, main clause information. On this view, many of the observed age differences can be attributed to changes in the efficiency of the child's procedures for interpreting a clause and to changes in the child's strategies for determining which clause contains the more important, asserted information of the sentence.

First, it is plausible to assume that young children's reduced memory span (*cf.* Huttenlocher and Burke, 1976) is accompanied by relatively inefficient comprehension procedures. If this assumption is valid (*cf.* Chi, 1976), the 3-year-olds' faster recognition of main clause probes in relative sentences is due to their incomplete analysis of the main clause and relative lack of attention to the subordinate clause. The fact that 3-year-olds responded more quickly to temporal and relative sentences with the main clause at the beginning of the sentence suggests that they may attempt to interpret the main clause first; the clauses of these sentences are ordered in the way the 3-year-old listener attempts to interpret them and in the way he searches his verbatim representation for the target. The lack of a main-subordinate difference among 3-year-olds on temporal sentences, however, remains unexplained by this analysis.

The second assumption is that the 4-year-old shifts from the 3-year-old belief that the important, asserted information is contained in the clause which is not preceded by a subordinate marker to the belief that the asserted information appears at the beginning of the sentence. This belief may come

about if the 4-year old notices that the important, asserted information usually does appear at the beginning of a sentence and then overgeneralizes that fact to indicate that the important information *always* occurs at the beginning. Assuming that 4-year-olds do have relatively inefficient computational procedures, there was support for this shift in strategy in the result that the 4-year-olds, unlike other groups, recognized first clause probes more quickly in relative and coordinate sentences, and by the result that the 4-year-olds as compared with other groups showed a larger first clause-second clause difference on comparative sentences. The shift in strategy is also supported by the fact that the 4-year-olds' performance, unlike that of other groups, was not disrupted by sentences with a subordinate clause at the beginning. On the other hand, under these assumptions the 4-year-olds should have responded more quickly to first clause probes in temporal sentences.

The results for 5-year-olds on temporal and relative sentences are generally consistent with the view that they postpone interpretation of the subordinate clause. The 5-year-olds responded more quickly to subordinate clause probes in both of these sentence types, and they responded more quickly to main first temporal sentences, although not to main first relative sentences. The interpretation of these results agrees with Amidon and Carey's (1972) finding that 5-year-olds often omit acting out the event in the subordinate clause. The present results for temporal and relative sentences therefore partially support the view that a dominant strategy in all age groups is to interpret the asserted information relatively early but that implementation of this strategy is affected by changes in the efficiency of comprehension procedures and by changes in the child's basis for deciding which clause contains the asserted information.

Comparative Sentences

The results for comparative sentences clearly do not support either the hypothesis that comprehension proceeds clause by clause or the hypothesis that main clauses are interpreted more quickly than subordinate clauses, since all age groups showed shorter latencies to the first (main) clause. The results for 3- and 4-year olds could be taken as support for the latter hypothesis (*cf.* Townsend, 1974; Townsend and Erb, 1975) if the assumptions proposed previously are valid. However, the adults' and 4-year-olds' shorter latencies to first (main) clause probes suggest that some other comprehension strategy is used either instead of or in conjunction with the strategy of interpreting main clause information first. Listeners may attempt to organize the clauses of comparative sentences around the event being compared (contained in the

main clause) as opposed to the event serving as the standard for the comparison. There is some evidence, for example, that in solving three-term series problems using comparative sentences adults construct an internal spatial array with the compared event being placed in the array first (Huttenlocher, 1968). In any case, the results indicate that listeners' comprehension strategies are not limited to a positional one of interpreting and rejecting verbatim information clause by clause or a structural-semantic one of first interpreting the asserted main clause.

Comparison of "Functional" Clauses

The results may be taken as partially supporting a functional account of clause comprehension, rather than the structural-semantic one presently proposed. Tanenhaus and Carroll (1975) have proposed that a surface clause which is more like an independent sentence is more readily recoded into an abstract form. If this proposal is correct, the ordering of latencies for clauses in a given sentence position should follow the order of most to least independent clause, with the most independent clause showing the longest latency. Ignoring sentences with center-embedded relative clauses, the clauses in the second position are ordered as follows from most to least like an independent sentence: main clause in a temporal sentence (*he touched the monkey*) > coordinate clause (*and he touched the monkey*) > subordinate clause in a temporal sentence (*after he touched the monkey*) = comparative clause (*faster than he touched the monkey*) > relative clause (*that touched the monkey*). The main clause in a temporal sentence is most like an independent sentence because it is not directly preceded by a conjunction or subordinating marker, and the relative clause is least like an independent sentence because it does not contain a normal sentential subject. Surprisingly, the observed latencies for adults and 5-year-olds follow this ordering, the only exception being the latencies for comparative clauses (*cf.* Table I). Thus the differences between latencies to different sentences may be partially attributed to differences in how readily different types of clauses are interpreted for meaning, which may be a function of the completeness of the clause. The main-subordinate distinction may represent only a portion of a continuum of completeness.

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