

COMPREHENSION OF SENTENCES IN APHASIC PATIENTS (1)

Understanding "before" and "after": A preliminary report

Sumiko Sasanuma and Akio Kamio

Clinical evidence suggests that disintegration of language processes in aphasia takes place not at random but in a highly predictable manner with some hierarchically organized order of difficulties. The impairment of sentence comprehension is no exception.

The preliminary report that follows constitutes the first of a series of investigations aimed at exploring the nature of strategies used by aphasic patients in comprehending sentences; it focuses on a particular group of sentences expressing temporal order of events, with special reference to the "order-of-mention" hypothesis suggested by E. Clark and H. Clark (1968) and E. Clark (1971).

This hypothesis states in essence that when the order of mention of events (hereafter abbreviated as OME) in a sentence corresponds to the order of occurrence of the events (hereafter abbreviated as OOE), comprehension is facilitated. Clark (1971) found, for instance, that for her three-year-olds, sentences (1) and (4) below were easier than (2) and (3).

- (1) He jumped the gate before he patted the dog.
- (2) Before he patted the dog, he jumped the gate.
- (3) He patted the dog after he jumped the gate.
- (4) After he jumped the gate, he patted the dog.

Suzuki (1972), applying an equivalent method to her 2;6 - 7;7-year-old Japanese children, found that (1) for sentences with "before" (where OME does not correspond to OOE) the error rate was generally much higher than that for sentences with "after" (where OME corresponds to OOE) and (2) for sentences with "before" the error rate was highest for her 3;0-3;5-year-olds, while (3) for sentences with "after" the error rate dropped to the lowest (zero) for children of 4;0-4;5 years (and it went up again after this age range). Taken together these findings would seem to indicate that the initial strategy children bring to bear in comprehending sentences with temporal relations is the order-of-mention strategy and that it becomes dominant around the age of 3;0-4;0 years. This seems essentially in accord with the findings of Clark (1971), and would appear to suggest that there are some hierarchically ordered stages of language acquisition where certain strategies emerge and become dominant over older ones, but are then subordinated to other strategies at a later stage of development.

In this study, we hoped to answer the following questions:

1. What strategies are used by aphasic patients in comprehending sentences which express temporal order of events?
2. How do their performances compare with the strategies used by normally developing children in different stages of language acquisition?

METHODS

The aphasic patients' comprehension of sentences expressing temporal order of events was measured by observing their responses to verbal commands.

Sentences

Forty sentences comprising five each of eight sentence forms (Table 1) were constructed.

Table 1. Eight Sentence Forms used in the Experiment

- A. VP₂¹⁾²⁾ ; before VP₁³⁾
Tokei⁴⁾ ni⁵⁾ sawatte⁶⁾ kudasai⁷⁾ ;⁸⁾ sono⁹⁾ maeni¹⁰⁾ chawaN¹¹⁾
ni sawatte kudasai. (Touch a watch; before that touch a bowl.)
- B. VP₂ before VP₁
Tokei ni sawaru maeni,¹²⁾ chawaN ni sawatte kudasai.
(Before touching a watch, touch a bowl.)
- C. VP₁ ; after VP₂
ChawaN ni sawatte kudasai; sono atode¹³⁾ tokei ni sawatte kudasai.
(Touch a bowl; after that touch a watch.)
- D. VP₁ after VP₂
ChawaN ni sawatta atode, tokei ni sawatte kudasai.
(After touching a bowl, touch a watch.)
- E. VP₁ then VP₂
ChawaN ni sawatte kara¹⁴⁾, tokei ni sawatte kudasai.
(Touch a bowl, then touch a watch.)
- F. VP₁ (and) VP₂¹⁵⁾
ChawaN ni sawatte tokei ni sawatte kudasai.
(Touch a bowl and touch a watch.)
- G. VP₁; VP₂
ChawaN ni sawatte kudasai; tokei ni sawatte kudasai.
(Touch a bowl; touch a watch.)
- H. VP with a coordinate NP
ChawaN to¹⁶⁾ tokei ni sawatte kudasai.
(Touch a bowl and a watch.)

1) VP: Since all the sentences are of polite imperative form and are, without explicit subjects in surface structure, we will in the following designate them as two VP's, although it may be linguistically correct to label them as two S's (clauses).

- 2) VP₂: Expressing the act to be performed second.
- 3) VP₁: Expressing the act to be performed first.
- 4) Tokei: watch
- 5) ni: A case particle for object.
- 6) sawatte (sawaru, sawatta): touch
- 7) kudasai: An auxiliary form for polite imperative or solicitation.
- 8) ;: With sentence-final falling intonation.
- 9) sono: that
- 10) maeni: before
- 11) chawaN: bowl
- 12) , : With an intermediate pause typically used for marking the boundary between subordinate and main clauses.
- 13) atode: after
- 14) kara: A case particle for "then".
- 15) For some speakers at least Sentence Form F can be distinguished from the other two control Sentence Forms G and H, implying that the act expressed by the first VP is to be performed before the act expressed by the second VP, while neither of Sentence Forms G or H seem to have such an "ordered" interpretation. However, since no clear results indicating this distinction have been obtained for this form in this study, it will not be examined in detail. This treatment would not substantially affect the discussion that follows.
- 16) to: A case particle for "and".

As can be seen, in Sentence Forms A and B (where a temporal conjunction "before" is used) OME does not correspond to OOE, while in Sentence Forms C, D, and E (where "after" or the equivalent conjunctions are used) OME mirrors OOE. The rest of the Sentence Forms, F, G, and H, do not make explicit use of any temporal conjunctions, and thus are designated as "control" sentences. Only one verb, "touch", was used in all sentences, while five nouns designating the names of manipulable objects (i. e., bowl, watch, coin, match, and scissors) were chosen as the objects of the sentences. In each of five sentences of the same form, two of these five nouns are used in such a way that each noun appears once in the preceding and once in the following verb phrases. (In Sentence Form H, each noun is placed once preceding and once following the coordinate conjunction "and".)

The 40 sentences were divided into five blocks of eight sentences, each (sentence of a block) representing one of the eight Sentence Forms shown in Table 1. The eight sentences in each block were ordered randomly to free the data from any order effects.

Preparation of tapes

Oral instructions for the task followed by a set of five practice sentences in addition to the main test battery of five blocks of eight sentences each, were read aloud by a trained female voice at a speed which is slightly slower than the average (roughly 4 seconds per sentence). The recording was made on a TEAC R-760 tape recorder. The interval between the sentences was five seconds. A signal "Hai" indicating "start" was inserted at the beginning of each sentence.

Procedure

In order to insure that the subject understood the task, each patient had a practice session consisting of (1) listening to the five practice sentences on the tape through the headphones (adjusted to his most comfortable listening level) and (2) responding to them immediately by means of acting out the commands (i. e., touching two items in the order indicated, out of five items which were in display in front of him). A maximum of 20 seconds was allowed the subject to respond to each sentence. When the subject understood the task the actual testing procedure began.

Subjects

A total of 25 patients have been tested thus far. The cause of aphasia was vascular in all cases; the mean age of the patient being 52.8 years (35 to 74 years), and the mean of post-onset period 9.4 months (3 to 57 months). Their aphasic syndromes represented both fluent and non-fluent types, ranging in severity from mild to moderate. All of them had normal hearing; and a pointing span of two or more items.

Scoring and data analyses

Any response which was at variance with the command (either in terms of the temporal order of touching two items or of the items actually touched) was scored as an error, with the maximum possible number of errors 40 per subject. These errors were then analyzed in terms of the following types:

- Type 1. Temporal error A: An error in temporal relations only.
- Type 2. Temporal error B: An error in temporal relations with an additional error in one of the two items.
- Type 3. Item error: An error in one of the two items only.
- Type 4. Irrelevant error: An error in both of the two items; or a "don't know", or "no" response.

RESULTS AND DISCUSSION

Group analyses

Aphasic patients as a group made a total of 176 errors out of 1000 (40 x 25) possible errors. Of these, 77 (or 43.7%) were of Type 1, and 16 (or 9.1%) Type 2, indicating that more than one half (93 or 52.8%) of the total errors were those due to a failure to comprehend temporal relations.

The next largest group of errors was that of Type 3 (73 or 41.5%) where the failure to comprehend one of the two items in the sentence (but not the temporal relation) was the cause of the error. Type 4, or irrelevant errors, constituted the smallest group, accounting for only 5.7% of the total errors.

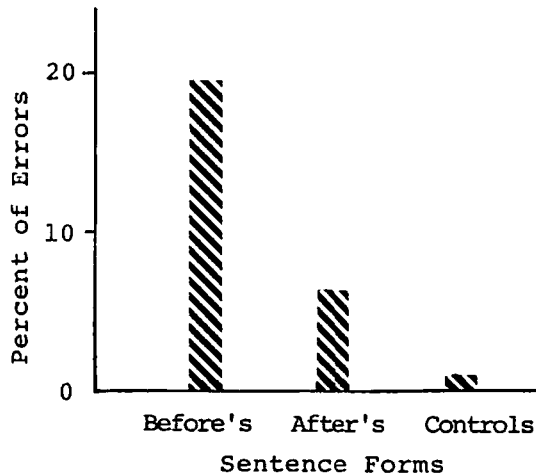


Figure 1. Relative distribution of Type 1 errors among three sets of sentence forms: Before's, After's and Controls.

An important finding is illustrated in Figure 1 above, which represents a breakdown of Type 1 errors (those involving temporal relations only) in terms of different Sentence Forms grouped into three sets:

- (1) Sentence Forms A and B ("Before's")
- (2) Sentence Forms C, D, and E ("After's"), and
- (3) Sentence Forms F, G, and H ("Controls")

It can be seen that the aphasic patients made more than three times as many errors for the sentences with "before" than for the sentences with "after"; and only a fraction of errors for "control" sentences. It would appear that when OME in a sentence does not correspond to OOE (as is the case with the sentences with "before"), comprehension is significantly impaired for the aphasics, and in trying to cope with these sentences they tend to revert to the strategy of relying on the order-of-mention.

As for the errors of other types (Types 2, 3, and 4), on the other hand, they were distributed evenly among all forms of sentences, indicating that occurrence of errors of these types are not selectively influenced by the different forms of sentences used in the experiment.

Individual analyses

Scrutiny of data has revealed that there is a sizable variability among patients in terms of the relative distribution of Type 1 errors (i. e., exclusive errors of temporal relations) among different forms of sentences. Three different patterns have been identified thus far:

Pattern 1: Predominant errors with Sentence Forms A and B ("Before's").

Pattern 2: Predominant errors with Sentence Forms C, D, and E ("After's").

Pattern 3: Predominant errors with Sentence Forms A through E ("Before's" as well as "After's").

The patients who exhibited Pattern 1 (which is equivalent to the pattern shown by the whole group as is illustrated in Figure 1) were eight in number and were characterized by the mild to moderate impairment of auditory comprehension as assessed by the overall performance level of the sentence comprehension task used in this experiment (i. e., 2 to 12 errors, with a mean of 6.8 errors).

There were four patients who showed Pattern 2; the degree of impairment of auditory comprehension for them also ranged from mild to moderate (i. e., 5 to 13 errors, with a mean of 8.3).

Pattern 3 was represented by three patients. Their auditory comprehension seemed to be somewhat more impaired than that of the above two groups, each one making 14 total errors in this sentence comprehension task. The errors exhibited by the rest of the patients were rather random and did not seem to fall into any of the above three patterns.

Unexpectedly, all the syndromes of aphasia (e. g., fluent vs. non-fluent; Broca's, or Wernicke's) were represented equally in each of the different error patterns above; i. e., no pattern seemed to discriminate among patients of different clinical groups. This is in accord with the findings of Goodglass (1968) on the grammar of English-speaking aphasics, and would seem to indicate that whatever hierarchies that might be found in the specific impairment of comprehending temporal order of events in sentences are similar among different clinical groups.

The specific nature of mechanisms underlying these three error patterns are not completely clear. Clark (1971), postulating the separate

semantic features (components) for "before" and "after", represented them as follows:

before	after
+Time	+Time
- Simultaneous	- Simultaneous
+Prior	-Prior

where [+Time] means that the item containing this feature refers to time and [-Simultaneous] has the meaning that the item relates two events which occur sequentially in time (unlike "when", which relates two simultaneous events and has the feature[+Simultaneous]). Finally, [+Prior] and [-Prior] appear only in words with the feature [-Simultaneous] and represent the meaning components earlier than and later than, respectively.

Clark's theory states that these features are acquired by children hierarchically from the superordinate component down, and from the positive value of the component to the negative value (i. e., [+Time] → (+Simultaneous) → [-Simultaneous] → [+Prior] → [-Prior]). If we apply this hypothesis to our data, assuming that the results from our adult aphasics reported above can be discussed within the same framework as those for young children, it may be that the patients showing the Pattern 3 impairment tend to confuse the two antonyms, "before" and "after", because they are just at that level of recovery where they have regained only the superordinate features, [Time] and [Simultaneous], but have not as yet recovered [±Prior], which distinguishes between the meanings of "before" and "after".

The patients exhibiting Pattern 2 impairment, on the other hand, tend to misinterpret "after" but not "before", because they have recovered to the stage where they know [+Time], [-Simultaneous] and [+Prior], which are the components contained in "before", but not the negative value of the component [Prior] ([-Prior]). The fact that the overall performance on the sentence comprehension task was better for the patients showing Pattern 2 impairment (the mean of 8.3 errors) than that for the patients showing Pattern 3 impairment (the mean of 14.0 errors) would seem to support this interpretation.

It would appear that Pattern 1, the selective impairment of comprehending (temporal relations in) sentences with "before", is most representative of aphasic responses in the sense that almost one third of the patients tested (8/25) exhibited this pattern; in addition, the result of the analysis of the group data has also shown a similar pattern of impairment (c. f. Group analyses above).

A possible explanation for this finding may again be obtained by referring to Clark's order-of-mention hypothesis: the aphasic patients tend to make an almost exclusive use of order-of-mention strategy when OME in the sentence does not correspond to OOE. The question arises, however, whether aphasics' reliance on this strategy is because of their inability to understand the meaning of either "before" or "after", as has been suggested by Clark (1971).

In Clark's account, children exclusively depend on the order-of-mention strategy when they have not yet acquired the meanings of "before" and "after". Subsequently, as they begin to understand the meaning of these words (in a fashion briefly summarized above), they come to process

the sentences with these words in terms of their meanings, and the use of the order-of-mention strategy correspondingly decreases. Thus, the strategy is assumed to operate only insofar as the acquisition of the meanings of "before" and "after" is incomplete. If this is also the case with our aphasic patients, then it is to be expected that the degree of impairment of sentence comprehension for the patients exhibiting this pattern will be higher than that of the other two subgroups exhibiting the impairment of Patterns 2 or 3. As a matter of fact, however, our data do not bear out this expectation; the mean number of the total errors of the patients exhibiting Pattern 3 impairment was 6.8, which was the lowest of the three subgroups.

Since the order-of-mention hypothesis is essentially independent of the semantic components hypothesis which says "before" is semantically less complex than "after". However, the use of the order-of-mention strategy does not necessarily presuppose the inability to understand the meaning of "before" and "after".

Another possibility would be that the sort of overall performance errors observed in this study might be basically independent of the understanding of sentences or words expressing temporal relations. If this is the case, then the degree of impairment could not be estimated from the total errors of the patients. The fact that errors of types 3 and 4 are evenly distributed among sentence forms might be an indication of the correctness of this interpretation.

Longitudinal studies of the patients following the stage-by-stage recovery processes, and identifying the change of strategies they use for sentence comprehension, may be in order for the clarification of this discrepancy.

References

- Clark, E. V. : On the acquisition of the meaning of before and after. J. of Verbal Learning and Verbal Behavior, 10, 266-275, 1971.
- Clark, H. H. and Clark, E. V. : Semantic distinctions and memory for complex sentences. Quarterly J. of Experimental Psychology, 20, 129-138, 1968.
- Goodglass, H. : Studies on the Grammar of Aphasics, in Applied Psycholinguistics Research, ed. S. Rosenberg and J. H. Koplein, New York: Macmillan Co., 1968.
- Suzuki, K. : "Comprehension of Sentences Expressing Temporal Order of Events for Children of Two to Six Years Old." Unpublished thesis, Keio University, 1962.