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COMPREHENSION OF SIMPLE SENTENCES AND RELATIVE CLAUSE CONSTRUCTIONS IN CHILDREN WITH HEARING DISORDERS*

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1. Introduction

Comprehension of sentences requires not only the knowledge of grammar of the language but also the use of certain processing devices which effectively map surface syntactic information onto semantic representations rather directly in real-time situations. After T. G. Bever (1970), we call these devices "perceptual strategies."

Our past study with normal adults as subjects (Uyeno and Harada 1975) revealed the role of perceptual strategies as canonizing the surface information into the format of a template, which has the form of Subject-Adverb-Object-Verb. Among the major syntactic cues used in perception, namely word-order, phrase structure hierarchy and particles, word-order is the most dominant cue and particles are the least dominant.

Previous studies (Hayashibe 1975 and Sano 1977) demonstrated the possibility of recapitulating the development of simple sentence comprehension in terms of acquisition of perceptual strategies. It has been observed that children come to incorporate the following three classes of sentences in this order into the repertory of manageable sentences:

(i) irreversible sentences,
(ii) normal word order reversible sentences, and
(iii) inverted word order reversible sentences.

These trends are best accounted for if we consider that children acquire the following perceptual strategies in the specified order:

(1) semantic strategy,
(2) SOV strategy, and
(3) particle strategy.

In these studies, it has been claimed that the strategies which utilize language specific cues (such as particles in Japanese) are acquired at a later stage of development than those strategies that depend on language universal features such as word order.

Our study on the comprehension of complex sentences (Harada, et al. 1976) revealed the developmental trends in different types of relative clause constructions, and the major strategies used in the comprehension

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of these constructions. The difference in surface structure of sentences affects comprehension to a considerable extent. Thus, center-embedding constructions were much harder to acquire than left-branching constructions, irrespective of the function of head nouns. The functions of the major strategies used in the comprehension of relative clause constructions were identification of clausal units and functional mappings of noun phrases. These strategies were identified with those employed in the comprehension of simple sentences; namely, the SOV strategy, and the particle strategy. Many instances of misinterpretation of relative clause constructions for conjunction construction were observed; they were considered to be due to abuse of the SOV strategy, which is acquired at an earlier stage.

The surface syntactic features shared by both relative clause constructions and conjunction constructions are the existence of a sentence-internal verb, which serves to mark a clause boundary, and the occurrence of a gap in surface clause form. The comprehension of these constructions thus requires the detection of a clause boundary at the site of the sentence-internal verb, and the recovery of nouns in the gap.

Distinctions between conjunction constructions and relative clause constructions in Japanese lie, first of all, in the sentence-internal verb forms: In the former the verb takes the V-te form, and in the latter it takes the finite form. Secondly, conjunction constructions may contain a gap in the second clause which is identical to a noun in the first clause, whereas relative clause constructions always contain a gap in the relative clause that is identical to the head noun.

Along these lines of research, we have conducted two experiments on the comprehension of children with hearing disorders (CHD hereafter), ranging in age from 6 to 15. It was expected that the study would reveal some characteristic aspects of the language development in CHD for whom the input linguistic information is extremely limited.

2. Experiment I

2.1. Materials

The test-items were twelve sentences, each of which was constructed with two nouns (marked with the subject particle ga and the object particle o and a verb. Six of these sentences were N-ga N-o V constructions (i.e., in normal word order (N)), and the other six were N-o N-ga V constructions, (i.e., in reversed word order (R)). They were presented one at a time in the listed order shown in the Appendix to half of the subjects. To the other half of the subjects, they were presented in the reversed order from the last item on. Test sentences are exemplified below, although in the actual presentation each item was typewritten in Hiragana 'Japanese syllabaries' on a card (15 x 21 cm).

N-ga N-o V: kuma ga usagi o tobikoeru
bear rabbit jump over

'The bear jumps over the rabbit.'

N-o N-ga V: sika o kuma ga taosu
deer bear knock down

'The bear knocks down the deer.'

The nouns and verbs used for the test sentences are the following:

Nouns: kirin (giraffe), kuma (bear), sika (deer), uma (horse), usagi (rabbit), and zoo (elephant)

Verbs: naderu (pat), taosu (knock down), and tobikoeru (jump over)

2.2. Subjects

The subjects were 77 children with hearing disorders but no mental retardation, ranging from 1st to 6th grade of elementary school (42 boys and 35 girls (6-12 years old)). Their mean hearing loss in speech range from 70 db to 90 db. They all attended Yokohama School for the Deaf. They were divided into six groups according to grades (1st: 8 children, 2nd: 19, 3rd: 16, 4th: 10, 5th: 14, 6th: 10).

2.3. Method

Each subject was interviewed individually. Before the test-items were given, the experimenter asked the subject to name the toys to be used in the experimental session in order to confirm that the subject was able to identify the toys correctly. The experimenter then showed typewritten instruction sentences: "Korekara ikutuka no bun o misemasu. Kaite aru koto ga wakattara omotya de yatte misete kudasai." (I'm going to show you some sentences. When you have understood what is written, show it to me with the toys.) Test items were presented one at a time in the order listed below* to half of the subjects and in the reverse order to the other half.

2.4. Results

The subjects can be classified into four groups according to their responses. The criteria of the grouping are shown in terms of fourfold tables as in the following examples:

Table 1

Group A

	OK	X
N	3	3
R	2	4

Group B

	OK	X
N	6	0
R	1	5

Group C

	OK	X
N	6	0
R	6	0

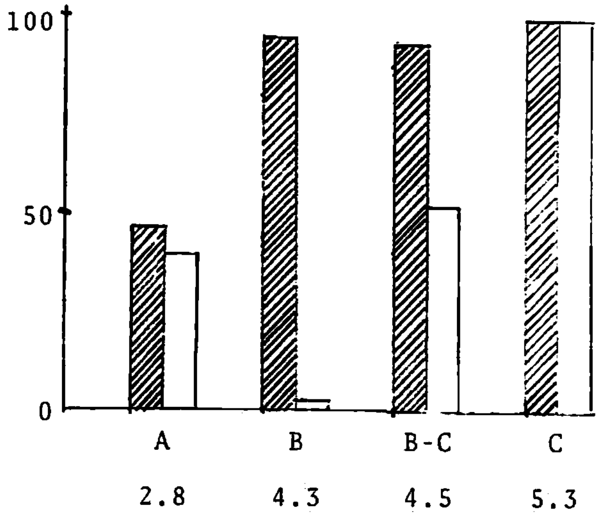
The numbers in the cells indicate correct (under OK)/incorrect (under X) responses to normal (N)/reverse (R) stimuli. The criteria for classification are as follows:

Group A: no cells are greater than 4.
Group B: correct responses to normal (N) are 5 or 6 and incorrect responses to reverse (R) are 5 or 6.
Group B-C: correct responses to N are 5 or 6 and incorrect responses to R are from 2 to 4.
Group C: correct responses to both N and R are 5 or 6.

*See Appendix I at the end of this paper.

Figure 1 indicates the percentages of the correct responses to N-ga N-o V constructions (shadowed) and N-o N-ga V constructions (blank) of each group.

Figure 1. Percentages of the Correct Responses to N-ga N-o V Constructions (shadowed) and N-o N-ga V Constructions (blank) of each Response Pattern Group.



The response pattern of Group A we will call the "random pattern," in which the percentages of the correct response to both N-ga N-o V and N-o N-ga V constructions were near the chance level, i.e., 50%.

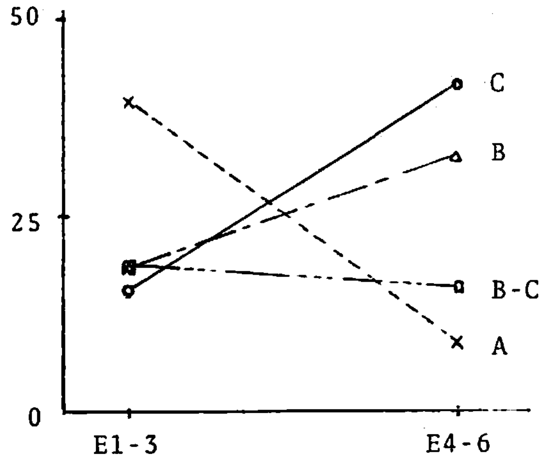
The response pattern of Group B we will call the "SOV strategy pattern." Children in this group are considered to utilize the SOV strategy, which interprets a sentence according to its word order: It interprets the first noun as subject and the second noun as object, regardless of particles attached to these nouns. This accounts for the fact that the children in this group respond correctly to the N-ga N-o V construction but not to the N-o N-ga V construction.

The response pattern of Group C will be called the "particle strategy pattern." Children in this group can be considered to utilize the particles in their comprehension of sentences. That is, they interpret N-ga as subject and N-o as object, regardless of their positions in a sentence.

The response pattern of the Group B-C comes between the SOV strategy pattern and the particle strategy pattern in respect to the number of correct responses to R sentences. Almost all the N sentences are correctly interpreted by this group. Either the SOV strategy or the particle strategy can explain this fact. The correct responses to R sentences in this group are, however, more than those in the group B but fewer than those in Group C. This fact indicates that the children in this group do not solely depend on the SOV strategy but they also use the particle strategy to some extent.

Figure 2 shows the percentage of each group, contrasting the younger group (consisting of the grades E1, E2, and E3, where E refers to elementary school) with the older group (consisting of E4, E5, and E6 grades).

Figure 2. Percentage of Response Patterns in the Comprehension of Simple Sentences by CHD Contrasting the Younger Group (E1-3) with the Older Group (E4-6).



We can observe that a) the frequency of the random pattern (Group A) is highest in the younger group and lowest in the older group, but b) the particle strategy pattern and the SOV strategy pattern are considerably higher in frequency in the older group than in the younger one. The rate of the SOV strategy pattern is not so large as that of the particle strategy pattern.

The average grades of the four groups are as follows:

Group A	Group B	Group B-C	Group C
2.8	4.3	4.5	5.3

This clearly shows the possibility of considering the order: Group A ⟶ Group B ⟶ (Group B-C) ⟶ Group C as reflecting the development of the CHD's (simple) sentence comprehension. As each group can be related to a specific strategy, the order above can be interpreted to indicate the developmental order of the strategies, namely, no particular strategies ⟶ the SOV strategy ⟶ (transition of the SOV strategy to the particle strategy) ⟶ the particle strategy.

It has already been observed that hearing children complete acquisition of such particles as ga and o by the age of six (Hayashibe 1975). According to our data from CHD, the point at which the correct responses exceed 50% is somewhere between the 4th and 5th grades (i.e., around the age of 10). Thus the retardation of CHD is obvious, but it should be noted that the order of the acquisition of strategies is exactly identical to that of hearing children.

3. Experiment II

3.1. Materials

The test-items consisted of fifteen sentences, twelve of which belonged to the relative clause construction: three sentences from each of the four types of relative clause construction (SS, SO, OS, and OO). Three extra sentences of the conjunction sentence construction were included as a control. The sentences were constructed with three nouns and two verbs chosen from the set of nouns and verbs used in Experiment I. Each of the five sentence types is illustrated in Table 1 below: The entire set of stimuli will be given in the Appendix.

Table 1

SS: [[zoo ga] kirin o taosite] zoo ga sika o nadeta
R(S) H(S)
elephant giraffe knocked down elephant deer patted
'The elephant that knocked down the giraffe patted the deer.'

SO: [zoo ga [kirin o] taosita] kirin ga sika o nadeta
R(O) H(S)
elephant giraffe knocked down giraffe deer patted
'The giraffe that the elephant knocked down patted the deer.'

OS: zoo ga [[sika ga] kirin o taosita] sika o nadeta
R(S) H(O)
elephant deer giraffe knocked down deer patted
'The elephant patted the deer that knocked down the giraffe.'

OO: zoo ga [kirin ga [sika o] taosita] sika o nadeta
R(O) H(O)
elephant giraffe deer knocked down deer patted
'The elephant patted the deer that the giraffe knocked down.'

C : [zoo ga kirin o taosite] [[zoo ga] sika o nadeta]
(S)
elephant giraffe knocked down elephant deer patted
'The elephant knocked down the giraffe and patted the deer.'

where H stands for the head and R for the relativized NP. The symbols S and O enclosed in parentheses stand for subject and object, respectively. The boxed elements are deleted by transformations and are thus absent from surface structure.

The reversibility of the sentences was fully taken into account so that no sentence in the set of test-items could be interpreted without assessment of the syntactic features of word order or particle choice.

The order of stimuli was first randomized and then controlled so that no sentence would follow another of the same construction type.

Each sentence was typewritten on a card in the same way as in Experiment I. Test sentences used are listed in the Appendix in the order of presentation.

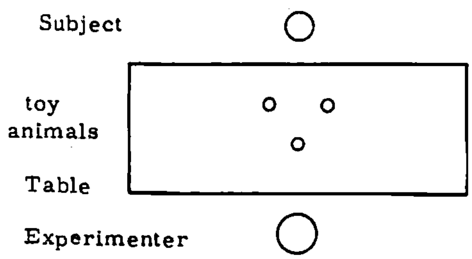
3. 2. Subjects

The subjects were 67 children with hearing disorders (35 boys and 32 girls) ranging from the 4th grade of elementary school to the 3rd grade of junior high school (hereafter, E4 for the 4th grade of elementary school E5 for the 5th, E6 for the 6th, J1 for the 1st grade of junior high school, J2 for the 2nd, and J3 for the 3rd). E4 consisted of 10 children; E5, 15; E6, 10; J1, 10; J2, 9; and J3, 13 children. The other conditions were the same as in Experiment I.

3. 3. Method

Experimental procedures were basically the same as in Experiment I, except in some details. The pre-session practice was given with six simple sentences. Following the pre-session practice, each subject was instructed to respond in the same way to the written test sentences. The three animals that would appear in the test sentence were then placed before the subject about 20 cm. apart from each other, in the shape of a triangle with the base downward (See Fig. 3). In order to avoid a response bias arising from the linear order positions of the animals in a sentence and the actual positions of the toy animals, the arrangement of toy animals was controlled so as not to coincide with their order of appearance in the given sentence.

Figure 3. Experimental Set-out



3. 4. Scoring

In each session, at least two observers (including the experimenter) witnessed the subject's performance. The results were recorded on a previously prepared scoring sheet using specially devised shorthand-like notations, e. g., EH-EG* (Elephant jumps over Horse, and then Elephant knocks down Giraffe).

3.5. Results and Discussion

3.5.1. Figure 4 presents the percentage of correct responses against total stimuli for the relative clause constructions (R) and for the conjunction constructions (C). Figure 5 represents the same results obtained from a previous experiment for hearing children (HC hereafter).

Figure 4. Percentage of Correct Responses against Total Stimuli (CHD)

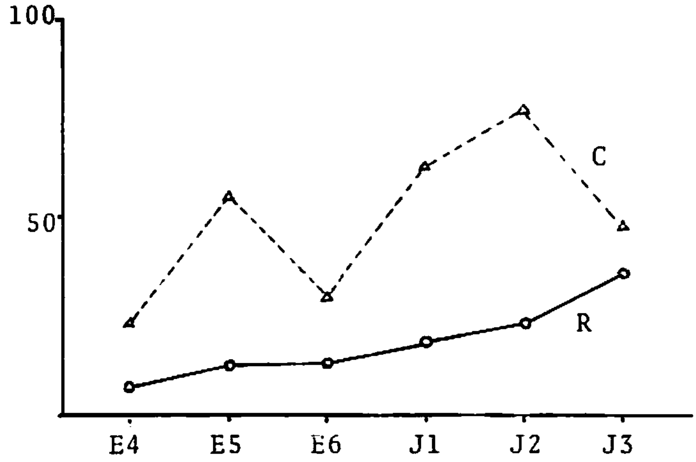


Figure 5. Percentage of Correct Responses against Total Stimuli (HC)

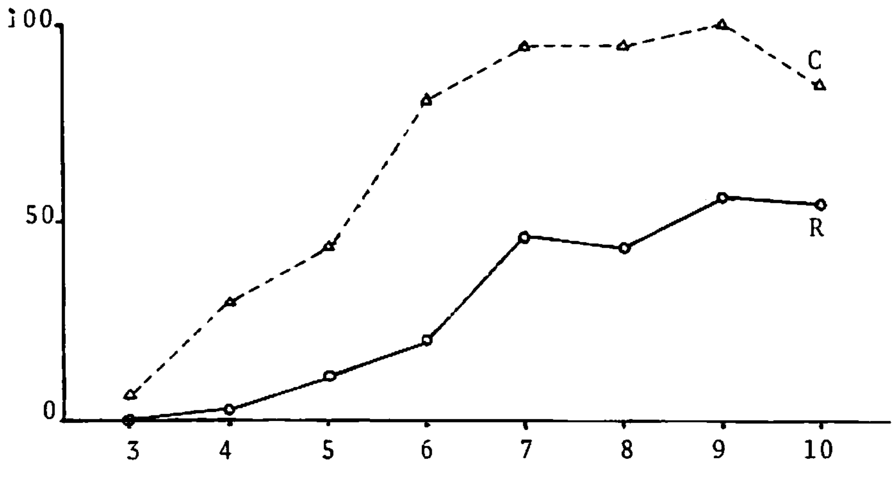


Figure 4 shows a tendency for the percentage of correct responses to increase with age for both C and R constructions. The percentage of correct responses to R gradually increases and is considerably lower than that of HC in Figure 5. For the C sentences, the graph shows irregular drops at E6 and J3 grades. These irregular drops seem due to the fact that, in these grades, there are relatively more subjects who show the responses peculiar to CHD. (Cf. 3.5.3. for a discussion of the responses peculiar to CHD.)

There is a considerable difference in the comprehension of R and C by the CHD. This was also true of the comprehension of the same constructions by HC in Figure 5. This means that processing of non-embedding, consecutive sentences such as C constructions is far easier than the processing of the sentences which involve embedding structures such as R constructions.

Figure 6 shows the development of the comprehension of each stimulus type (SS, SO, OS, OO) in a percentile scale. Figure 7 is the case obtained from the experiment with HC. Figure 6 clearly shows that four sentence types can be grouped into two, SX (SS and SO) and OX (OS and OO), according to percentage of the correct responses. Note that below J1 there is no correct response found for the OX type.

Figure 6. Percentage of correct responses to each stimulus type (CHD)

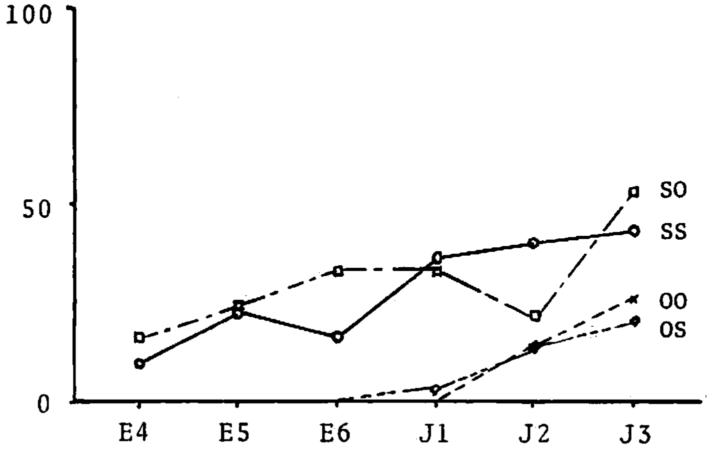
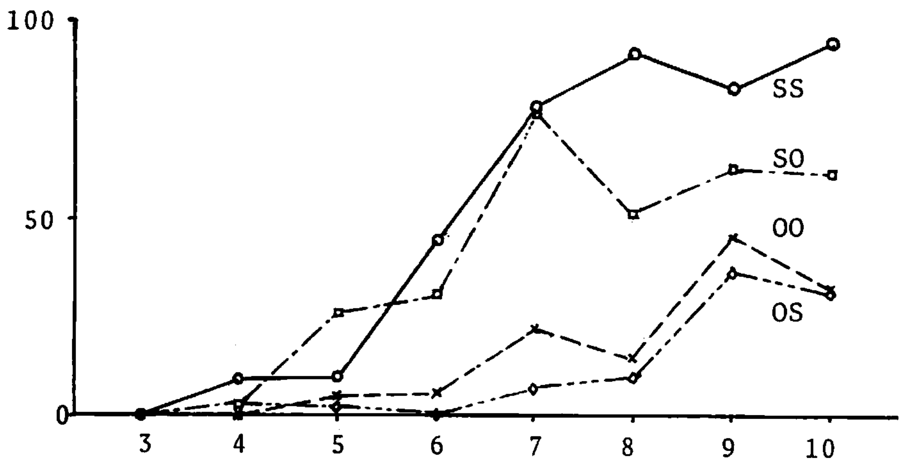


Figure 7. Percentage of correct responses to each stimulus type (HC)



This apparent difference in SX and OX indicates that some mechanism other than grammatical rules is at work in the comprehension of relative clauses by CHD, because relevant grammatical rules for the comprehension of relative clause (Relative Clause Formation) should treat SX and OX in the same way, and thus could not account for the difference between them. This was already discussed in our previous study on HC (Harada, et al., 1976), and we contend that the mechanism at work is the so-called PERCEPTUAL STRATEGIES. This parallelism indicates that the explanation we proposed for the facts observed with respect to HC can be applied here also.

Note that OX shares the same word order with C, as opposed to SX.

SX: N-p V N-p N-p V

OX:, C: N-p N-p V N-p V

(where N stands for a noun, V a verb, and p a particle)

We can then hypothesize that CHD, just as HC, predominantly follow a perceptual strategy which makes crucial use of the input word order — what we called the "SOV" strategy. This strategy segments out any sequence of two nouns followed by a transitive verb as a clause and assigns the grammatical relations "subject" and "object" to the initial and the second noun respectively.

$$X\ N\text{-}p\ N\text{-}p\ V\ Y \longrightarrow X'\ [_S\ N_{Subj}\ N_{Obj}\ V]\ Y'$$

This strategy gives the correct interpretation to type C stimuli but the incorrect interpretation to types OS and OO. This explains why correct responses to OX were so infrequent.

If this account is correct, the errors to OX type stimuli should include a large proportion of misinterpretation as C type (which we will call "C-errors"). As will be seen in the next section, this prediction is borne out (see Figure 8 and discussion there).

3.5.2. Let us proceed to a closer examination of the major response patterns. Table 2 is a list of the response patterns that occur in more than 5% of the total responses. Response patterns are arranged in order of frequency with their percentage indicated in parentheses (Responses below five percent are neglected.).

Table 2. Frequent Response Patterns of CHD Arranged in the Order of Frequency (The figures in parentheses indicate percentage.)

		1	2	3	4
SS	∅ (30.3)	21 23 (28.9)	12 23 (24.9)	13 23 (5.4)	
SO	∅ (39.8)	12 23 (31.8)	12 13 (8.0)	21 23 (6.0)	
OS	∅ (32.3)	12 13 (30.8)	12 31 (10.0)	12 23 (7.5)	
OO	∅ (50.2)	12 13 (11.4)	12 23 (9.5)	12 32 (6.5)	12 31 (5.5)
C	12 13 (44.8)	∅ (24.8)	12 31 (8.0)	12 23 (5.5)	

Sequences of digits like 21 23 in this table indicate a response pattern. Each digit refers to a noun in the stimulus sentence identified with the order in which it appears. The first two digits correspond to the first half of a response and the last two digits to the last half of the response. The order of two digits indicates the subject-object relations. Thus, 21 23 means that the child interpreted the second noun as the subject of the first verb and the first noun as its object, then the second noun as the subject of the second verb, and the third noun as its object. "Ø" indicates a deviant response pattern.

We can observe several interesting differences between the stimulus types.

First pattern Ø takes the highest score in every construction except C. Pattern Ø is a peculiar pattern observable only in the CHD responses, and will be discussed in 3. 5. 3. In the responses to C, the correct response pattern 12 13 takes the highest score. This shows the same fact as was already observed in Figure 4: that C construction is far easier than R constructions.

Next, we can observe that the most frequent response pattern to the SX type stimuli was, apart from those incorrect responses of pattern Ø, the correct response to each sentence type (21 23 for SS, and 12 23 for SO). In contrast, we cannot find correct responses to OX type stimuli (32 13 for OS and 23 13 for OO) among the response patterns exceeding 5%. The most frequent response pattern to the OX type stimuli, besides pattern Ø, is the C-error pattern, 12 13. But this is in fact predicted by the hypothesis made in the foregoing section that the SPV strategy is also working in the comprehension of relative clause constructions, in particular, in the comprehension of OX type relative clause constructions. The existence of the SOV strategy seems to be corroborated by the fact that the first half of the response to OO, OS, and C is always 12.

If we assume the existence of the SOV strategy we can account for the fact that the correct response to OX is very low in frequency but not for the fact that SX is easier than OX. Thus, we must assume another strategy to account for the SX data.

SS: N-o V N-ga N-o V
SO: N-ga V N-ga N-o V

We might think that the SOV strategy is not prompted if there is only one N in front of the verb. The strategy which works instead in such a case should recover an N which is semantically present but formally absent in the stimulus sentence. Note that such a gap-filling process is already assumed in the comprehension of C sentences. We will call this the FILL OUT strategy. In order for this strategy to correctly interpret the SX sentences, the lexical knowledge of the transitivity of the verbs must have already been given, since if the V of N-p V is interpreted as intransitive rather than transitive, then no gap will be recognized and the Fill Out strategy will not be called into play. The choice between the SOV strategy and the Fill Out strategy is made according to the number of NPs before the Verb.

These two strategies are not cumulatively applied; it seems that the processor makes a choice between them, depending on the number of NP's that appear before the verb. If there is only one NP then the Fill Out strategy is chosen; if there are two, the SOV strategy is applied.

Figure 8 shows that the tendency to make C-errors of CHD bears a strong parallelism to the correct responses of C sentences at all grades.

As we have stated, this indicates that the SOV strategy is predominant in the comprehension of relative clauses and that particles do not play a significant role.

Figure 8. Percentage of C-errors to OS and OO Stimuli for CHD, Compared with that of Correct Responses to C.

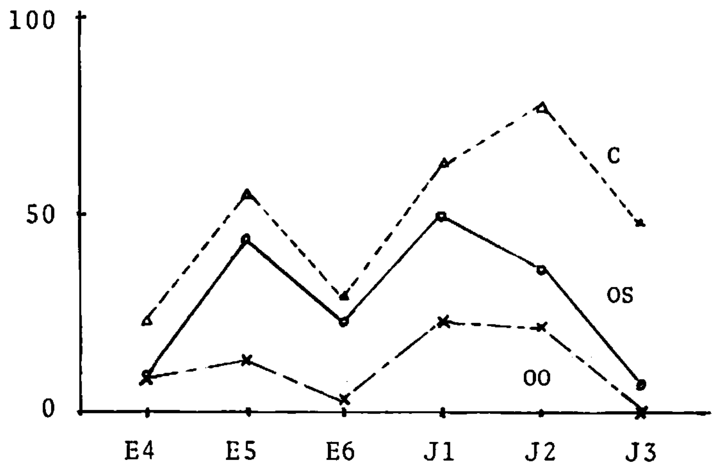
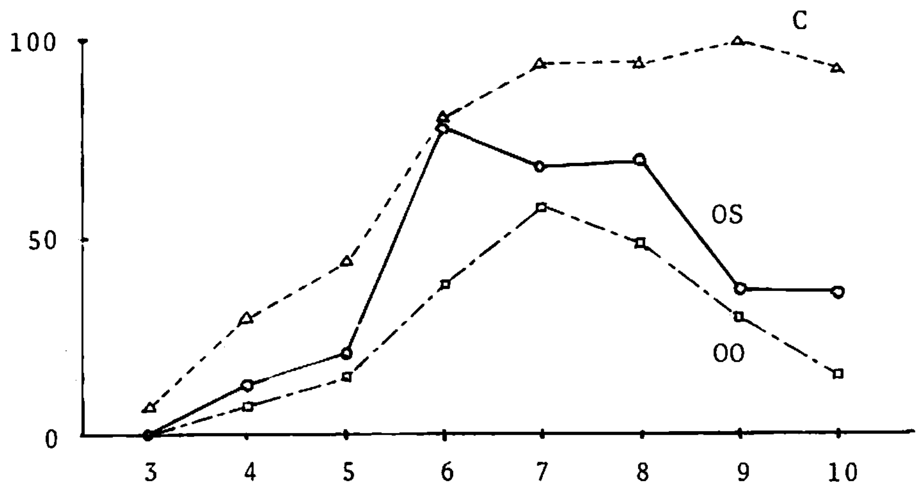


Figure 9. Percentage of C-errors to OS and OO Stimuli for HC, Compared with that of Correct Responses to C.



However, the difference between OS and OO in Figure 8 might be due to the different particle patterns :

OS: N-ga N-o V N-o V

OO: N-ga N-ga V N-o V

Note that the sequence of Particles ga-o that occurs in OS is the same as in the C sentence. It seems quite probable that this affinity to C sentences has induced the frequent misidentification of OS as C (see the above discussion of Table 2) and led to the difference between OS and OO observed in Figure 8. Therefore we might say that although the SOV strategy is predominant, there is a sign of the development of the particle strategy at this stage.

3.5.3. So far, we have discussed the results of the experiment with CHD referring to the results obtained from the previous experiments with HC. We will now turn to the examination of the responses peculiar to CHD. We will, in particular, go over the contents of pattern Ø, which have not been observed in the case of HC.

Any normal response to SS, SO, OS, OO, and C sentences can be described in the form of NNV NNV, where each sequence NNV indicates an event in which the first N is the agent and the second N is the patient of the action expressed by V. Any other response is regarded as belonging to a deviant pattern: pattern Ø. Typical pattern Ø responses are:

(NN) NV: two agents + one patient + verb (the child performs an action with two agents and one patient.)

(NN)V: two agents + verb (intransitive response, that is, no patient involved in the act-out response)

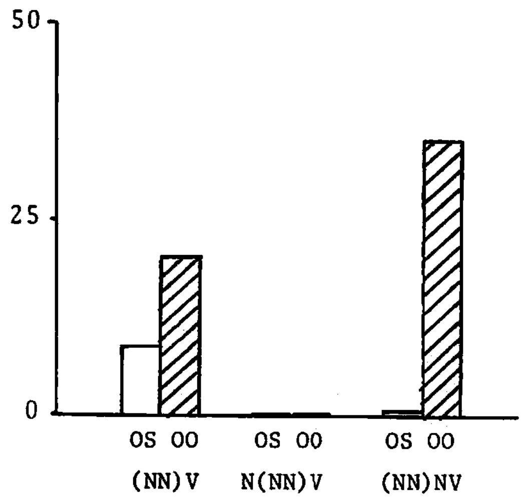
NV: one agent + verb (intransitive response with single agent)

N(NN)V: one agent + two patients + verb

The percentage of these responses fluctuates between 50% (the 4th grade of elementary school) and 25% (the 3rd grade of junior high school). A close scrutiny detects the existence of some systematic tendencies in these deviant responses.

First, see Figure 10, which shows the percentages of (NN)V, N(NN)V, and (NN)NV in the first half of the responses to OS and OO sentences.

Figure 10. Frequency of Three Deviant Response Patterns which Involve (NN) Configuration in the First Half of OS and OO



In Figure 10 we can immediately see that the deviant pattern (NN) NV is more frequent in the first half of the response to OO sentences than to OS sentences.

(1) (NN)NV : OO ≫ OS

The deviant response (NN)V is also greater in the responses to OO sentences than in the responses to OS. In contrast to (NN)NV responses, the difference between OO and OS is not so great with respect to (NN)V responses.

(2) (NN)V : OO > OS

We must explain why OO has induced more deviant patterns than OS, and furthermore, why the difference between OO and OS is much greater for (NN)NV than for (NN)V.

As already noted, the superficial difference between OO and OS is that the second noun of the OO sentence is marked with the particle ga and that of the OS sentence is marked with the particle o. Therefore, the difference indicated in (1) can be naturally explained if we suppose that the subjects of the experiment are highly sensitive to the existence of the particles, especially, to the particle ga. In other words, if we assume the Particle Strategy we can naturally explain the difference in (1). We will tentatively schematize this strategy in the following way:

$$W \ X \ N + ga \ Y \ Verb \ Z \longrightarrow W' \ [_S \ X' \ N_{Subj} \ Y' \ Verb \ ] \ Z'$$

Note that the output of this strategy must be constrained by a fairly general condition that a verb cannot take two or more terms which bear the same grammatical relation, which we call the Uniqueness Condition. That is, such grammatical relations as Subject, Object, and Indirect Object should be uniquely assigned to a noun within a clause. The appearance of the deviant responses (NN)V and (NN)NV strongly suggests that many of the CHD's apply Particle Strategy but do not obey the above condition. This explains the difference observed in the percentage of (NN)NV responses between OO and OS. This is not capable of explaining the difference between (NN)V and (NN)NV, however, especially because it fails to explain why a considerable number of deviant responses (NN) are observable in OS sentences. OS sentence has the sequence ga-o and thus the ga particle strategy alone cannot yield the (NN) response. Therefore, we must conclude that the (NN) responses in (NN)V and (NN)NV are due to different factors. We conclude that CHD employ a version of word order strategy, which interprets any NP appearing in front of a verb as Subject. Note that this explanation presupposes that CHD, whose responses to OX are (NN)V, do not have knowledge of the lexical frame of transitive verb. Thus, we can explain the above facts when we incorporate the development of the lexical frame from intransitive to transitive and consider (NN)V to be the reflection of the intransitive stage of the development. If a subject has an intransitive lexical frame, then he may interpret the sequence NNV as (NN)V. Note that at this stage of development, particles cannot be the crucial factor for this deviant interpretation since OS has a ga-o sequence.

Thus far, we have observed that the peculiar responses of CHD can be explained by two things. One is a version of Particle Strategy which assigns an (NN)NV interpretation to OO without the Uniqueness Condition, and the other is the INTRANSITIVE lexical frame which interprets OO and OS sentences as beginning with an (NN)V.

4. Summary

The developmental trends of sentence comprehension in CHD were studied in two experiments and were analyzed from the point of view of Perceptual Strategies. The SOV strategy and the particle strategy are shown to be employed in the comprehension of simple sentences. In addition to these, the Fill Out strategy, which recovers a gap within a clause, is employed in the comprehension of relative clause constructions. The SOV strategy is acquired earlier than the particle strategy. With regard to the developmental details of the Fill Out strategy, further studies are needed. These developmental trends are those shared by HC, though in the case of CHD the development starts at a much later stage than HC and proceeds gradually.

A salient feature of the development of sentence comprehension in CHD was the occurrence of pattern Ø responses as the most frequent ones in every type of relative clause constructions. Among the responses to type OX stimuli especially (a) (NN)NV, and (b) (NN)V patterns were observed frequently. The (NN) NV pattern represents a violation of the Uniqueness· Condition, in spite of the particle strategy operative in identifying nouns accompanied by the particle <u>ga</u> as subjects. The (NN)V pattern seems to be due to the interpretation of transitive verbs as intransitive ones, in addition to the violation of the Uniqueness Condition as in (a).

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Appendix I

Test-sentences used in Experiment I (numbers indicate the order of presentation)

1. (N) kuma ga usagi o tobikoeru
   bear rabbit jump over

   'The bear jumps over the rabbit.'

2. (N) zoo ga uma o taosu
   elephant horse knock down

   'The elephant knocks down the horse.'

3. (N) uma ga usagi o naderu
   horse rabbit pat

   'The horse pats the rabbit.'

4. (R) sika o kuma ga taosu
   deer bear knock down

   'The bear knocks down the deer.'

5. (R) zoo o kirin ga naderu
elephant giraffe pat

'The giraffe pats the elephant.'

6. (R) kirin o kuma ga tobikoeru
giraffe bear jump over

'The bear jumps over the giraffe.'

7. (N) sika ga usagi o taosu
deer rabbit knock down

'The deer knocks down the rabbit.'

8. (N) usagi ga zoo o naderu
rabbit elephant pat

'The rabbit pats the elephant.'

9. (R) uma o sika ga tobikoeru
horse deer jump over

'The deer jumps over the horse.'

10. (R) uma o kirin ga taosu
horse giraffe knock down

'The giraffe knocks down the horse.'

11. (N) zoo ga kirin o tobikoeru
elephant giraffe jump over

'The elephant jumps over the giraffe.'

12. (R) kuma o sika ga naderu
bear deer pat

'The deer pats the bear.'

Appendix 2

The test-sentences used in Experiment II
(Numbers indicate the order of presentation)

1. (SO) zoo ga nadeta kuma ga sika o taosita
elephant pat bear deer knock down

'The bear the elephant patted knocked down the deer.'

2. (C) kirin ga usagi o tobikoete uma o taosita
giraffe rabbit jump over horse knock down

'The giraffe jumped over the rabbit and knocked down the horse.'

3. (OO) zoo ga kuma ga nadeta sika o tobikoeta
elephant bear patted deer jumped over

'The elephant jumped over the deer the bear patted.'

4. (SS) kirin o nadeta uma ga zoo o taosita
giraffe patted horse elephant knocked down

'The horse that patted the giraffe knocked down the elephant.'

5. (OO) kuma ga zoo ga tobikoeta usagi o nadeta
bear elephant jumped over rabbit patted

'The bear patted the rabbit the elephant jumped over.'

6. (SO) uma ga tobikoeta sika ga kirin o nadeta
horse jumped over deer giraffe patted

'The deer the horse jumped over patted the giraffe.'

7. (C) usagi ga sika o taosite kuma o tobikoeta
rabbit deer knock down bear jump over

'The rabbit knocked down the deer and jumped over the bear.'

8. (OS) usagi ga kirin o taosita uma o tobikoeta
rabbit giraffe knock down horse jumped over

'The rabbit jumped over the horse that knocked down the giraffe.'

9. (SO) kuma ga taosita zoo ga usagi o tobikoeta
bear knocked down elephant rabbit jumped over

'The elephant the bear knocked down jumped over the rabbit.'

10. (OS) uma ga sika o nadeta kirin o taosita
horse deer patted giraffe jumped over

'The horse knocked down the giraffe that patted the deer.'

11. (C) sika ga uma o taosita kirin o nadeta
deer horse knocked down giraffe patted

'The deer knocked down the horse and patted the giraffe.'

12. (SS) zoo o tobikoeta kuma ga sika o nadeta
elephant jumped over bear deer patted

'The bear that jumped over the elephant patted the deer.'

13. (OS) sika ga usagi o nadeta kuma o tobikoeta
deer rabbit patted bear jumped over

'The deer jumped over the bear that patted the rabbit.'

14. (OO) kirin ga uma ga nadeta zoo o taosita
giraffe horse patted elephant knock down

'The giraffe knocked down the elephant that the horse patted.'

15. (SS) usagi o tobikoeta kirin ga uma o taosita
rabbit jumped over giraffe horse knocked down

'The giraffe that knocked down the horse jumped over the rabbit.'

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