

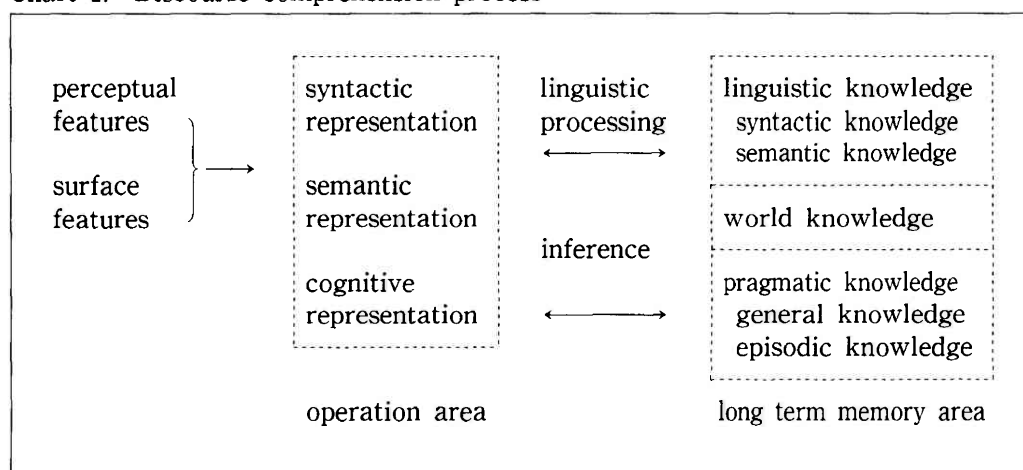
DISCOURSE COMPREHENSION AND HUMAN MEMORY¹

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1. Introduction.

Discourse comprehension is crucially directed by human memory system. In Toda (1986:170), it is analyzed as in Chart 1: perceptual features are processed and formed into several inner representations, that is to say, understanding procedure takes place in the operation area. The aim of this paper is to clarify discourse processing from the viewpoint of interaction between a text and its inner representations (syntactic structure representation, semantic structure representation, cognitive structure representation, etc.) on the one hand, and human memory system on the other.

Chart 1. Discourse comprehension process



In Section 2, we will review the theory of cohesion in Halliday & Hassan 1976 and a model of discourse comprehension and memory named '3.5 leveled memory

model' in Tanaka 1979. In Section 3, a new model will be proposed to handle the problems which defy logical analysis by the preceding theory or model (ex. the problems of substitutions, ellipses, and other cohesive devices).

2. Discourse comprehension.

2.1. Cohesion.

In Halliday & Hassan 1976, the following syntactic figures are pointed out as cohesive devices: references, substitutions, ellipses, conjunctions, lexical cohesions².

First, the characteristic of references is this: instead of being interpreted semantically in their own right, they make reference to something outside themselves for their interpretation. In English these items are personals, demonstratives and comparatives. Examples are shown as follows (*ibid*: 31).

- (1) a. Three blind mice, three blind mice. See how *they* run! See how they run!
- b. Doctor Foster went to Gloucester in a shower of rain. He stepped in a puddle right up to his middle and never went *there* again.
- c. There were two wrens upon a tree. *Another* came, and there were three.

In 1a, *they* refers to *three blind mice*; in 1b *there* refers to *Gloucester*; in 1c *another* refers to *wrens*. The references in these cases are called endophora, because they have referents in their texts themselves. In other cases, in which references have their referents in the contexts or situations of the texts, they are called exophora.

Second, Halliday & Hassan discuss substitutions and ellipses in comparison with references, and point out the distinction as follows: reference denotes a relation in meaning, while substitution and ellipsis denote a relation in wording (*ibid*: 89). This is important; indeed, this can be one of the counter-examples to the former models of discourse understanding and memory, for, if we follow Halliday & Hassan in understanding the 'relation in wording', we are necessarily led to this conclusion: not only the memory of meaning but that of wording itself can play a crucial part of discourse understanding, which we shall be discussing in Section 3.

The principle distinguishing reference from substitution is reasonably clear.

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Substitution is a relation between linguistic items, such as words or phrases ; whereas reference is a relation between meanings. In terms of the linguistic system, reference is a relation on the semantic level, whereas substitution is a relation on the lexicogrammatical level, the level of grammar and vocabulary, or linguistic 'form'. Ellipsis, as we have already remarked, is in this respect simply a kind of substitution ; it can be defined as substitution by zero. So we have :

Type of cohesive relation :	Linguistic level :
Reference	Semantic
Substitution (including Ellipsis)	Grammatical

As for substitutions, they have 2a and 2b as examples (*ibid* : 89),

- (2) a. My axe is too blunt. I must get a sharper *one*.
b. You think Joan already knows? — I think everybody *does*.

One and *does* are substitutions for *axe* and *knows*, respectively. In explaining the substitution in 2a, one would first ask : What word does 'one' stand for? Similarly with the verb 'does' in 2b. Ellipsis, as it was mentioned above, is defined as substitution by zero, and they have 3 (*ibid* : 143),

- (3) a. Joan brought some carnations, and Catherine some sweet peas.
b. Would you like to hear another verse? I know twelve more.

In 3a, the second clause is interpreted : Catherine *brought* some sweet peas. In 3b, the second clause is interpreted : I know twelve more *verses*. In explaining the ellipsis of 3a, one would first ask : What word should be supplied between 'Catherine' and 'some'. Similarly with the gap at the end of 3b.

Conjunction is rather different in nature from other cohesive relations, and it does not have anaphoric relation in the discourse or text in its own right. It has a function to relate language elements which have no structural relations at all. They find four categories in conjunction as in 4 : additive, adversative, causal, and temporal. (*ibid* : 238)

- (4) For the whole day he climbed up the steep mountainside, almost without stopping.
a. And in all this time he met no one. (additive)
b. Yet he was hardly aware of being tired. (adversative)
c. So by night time the valley was far below him. (causal)
d. Then, as dusk fell, he sat down to rest. (temporal)

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Lexical cohesion is the cohesive effect achieved by the selection of vocabulary. They have examples as in 5. (*ibid* : 278)

- (5) a. There was a large *mushroom* growing near her, about the same height as herself ; and, when she had looked under it, it occurred to her that she might as well look and see what was on the top of it. She stretched herself up on tiptoe, and peeped over the edge of the *mushroom*, ...
- b. Accordingly ... I took leave, and turned to the *ascent* of the peak. The *climb* is perfectly easy ...
- c. Then quickly rose Sir Bedivere, and ran,
And leaping down the ridges lightly, plung'd
Among the bulrush beds, and clutch'd the *sword*
And lightly wheel'd and threw it. The great *brand*
Made light'nings in the splendour of the moon ...
- d. Henry's bought himself a new *Jaguar*. He practically lives in the *car*.

In 5a, there is repetition: *mushroom* refers back to *mushroom*. In 5b, *climb* refers back to *ascent*, of which it is a synonym. In 5c, *brand* refers back to *sword*, of which it is a near synonym. In 5d, *car* refers back to *Jaguar* ; and *car* is a superordinate of *Jaguar* — that is, a name for a more general class.

2.2. Discourse understanding and memory model.

In this section we will review the '3.5 leveled memory model' in Tanaka 1979. It has four categories as in Chart 2, where there is no distinct line of demarcation between MT and IMT, hence the naming: "three and a half" instead of "four".

Chart 2. 3.5 leveled memory model (Tanaka 1979 : 210)

ST, Short – Term Memory	
MT, Mediate – Term Memory	IMT, Implicit Mediate – Term Memory
LT, Long – Term Memory	

Each category is defined as follows (*ibid* : 212):

- i. Short – Term Memory (ST): ST is the limited capacity buffer where the

sentence we hear or read is held for a while in the exactly or almost the same form of the sentence we heard / read. When a new sentence comes into ST, it replaces the previous sentence almost entirely.

- ii. Mediate – Term Memory (MT) and Implicit Mediate Term Memory (IMT): A current discourse is held in MT and IMT, while the building up of the macro structure, the situational model and other features of the given discourse is under way.
- iii. Long – Term Memory (LT): LT holds quite systematic knowledge which we have got from our experiences; general knowledge, lexical knowledge, frame, epinodic memory.

IMT also contains the inferences we get from the given discourse.

In the following discussion, we will show the relation between discourse understanding and memory system with the examples given in Section 2.1 5d.

(5) d. Henry's bought himself a new *Jaguar*. He practically lives in *the car*. When we hear / read *Jaguar*, the copy of the Jaguar frame in LT is made in MT. On the other hand, we will have inferences like 'Henry loves the new car very much,' in IMT. When we hear / read the second sentence, we can interpret *the car* as referring to a new Jaguar since we have had 'Jaguar is a car' in Jaguar frame in MT. On the strength of the inference we make in IMT, as mentioned above, those two sentences fit together as a whole, non-contradictory, discourse.

In the next section, we will point out some problems in the '3.5 leveled memory model' which come up when the model is applied to cohesive phenomena observed in Section 2.1, and propose a new model which can cope with the difficulties.

3. Multiple cycle memory model.

3.1. Problems in 3.5 leveled memory model.

In the early days of human history, when they had no language worthy of the name, information processing was pursued mainly in some analogous imagery procedure. The task of this section is to point out that this 'analogous imagery information processing' is still working well in discourse understanding in the present day: that is to say, this analogous imagery memory as applied to the text itself (= a set of word-forms) plays important roles in our discourse understanding. Thus we extend the '3.5 leveled memory model' to outside of episodic memory. In other words, we should note that not only episodic cognitive

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representations have their own 3.5 leveled memory cycle (short term memory, mediate term memory, long term memory), but also linguistic representations, and even sensory representations have their own 3.5 leveled memory cycle.

3.1.1. First, we use the concept of cohesion in Halliday & Hassan 1976 to show that each inner representation has its own 3.5 leveled memory cycle. Cohesion itself is not a new concept in the field of discourse analysis, it is true, but it is only pronouns that have been taken up in van Dijk and Kintsch 1983. This is genuinely lamentable. We hold, however, that other manifestations of cohesion, such as substitution, ellipsis and other grammatical devices, can serve as a critical evidence for our view of discourse processing as a system which has memory cycle at each of its levels of processing.

Of the five cohesions observed in 2.1, reference, conjunction and lexical cohesion relate to the cognitive representation shown in Chart 1. Let us examine a reference in 1a, for example,

(1) a. Three blind *mice*, three blind *mice*.

See how *they* run! See how *they* run!

Mice in the first sentence introduces the 'mice frame' in LT come to MT. As *they* refers to *mice*, the same frame continues to be in MT, which works as cognitive representation.

Conjunction too relates to the cognitive representation, because, as was shown in 4 a-d, it functions as connector on the basis of world knowledge and pragmatic knowledge as in Chart 1, which belong to LT. Likewise, lexical cohesion relates to cognitive representation on the basis of frame knowledge as is shown in example 5d.

Now let us turn to the substitution and ellipsis cases. Do these two devices also hinge on cognitive representation? The answer is clearly 'No'. In the following discussion, we will show that they belong to the process which precedes cognitive representation: here it is syntactic representation that comes into full play in discourse processing. As observed in the examples of substitution and ellipsis from Halliday & Hassan in 2.1; while reference belongs to 'semantics' (in our term: cognitive representation), substitution and ellipsis belong to 'grammar' (in our term: syntactic representation).

Inasmuch as word-form is a kind of thing-form, it is perceptible to sense organs,

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and its image is an analogous image just like the image of, say, a dog (=the shape / the barking sound of a dog, see Chart 3). And this is just where the processing of analogous image comes in. As we have noted above, the first question one asks in explaining substitution and ellipsis is about the word-form which has been held in memory.

Chart 3.

image of the word 'dog'	image of a dog
representations of the arrangement of the letters 'd', 'o', 'g', the pronunciation of the word [dɔg], etc.	representations of the canine features, the sound of barking, etc.

We will clarify the relation between discourse understanding and memory cycle by examining the examples below. The syntactic structure of substitution is given in (2)'.
(2)'

- a. $\{s\{_{NP}my\ axe}\{_{VP}is\ too\ blunt}\}$
 $\{s\{_{NP}I}\{_{VP}must\ get\{_{NP}a\ sharper\ one}\}\}$
 b. $\{s_1\{_{NP}you}\{_{VP}think\{s_2\{_{NP}Joan}\{_{VP}already\ knows}\}\}\}\}$
 $\{s_1\{_{NP}I}\{_{VP}think\{s_2\{_{NP}everybody}\{_{VP}does}\}\}\}\}$

In 2'a, the structure of the first sentence will be copied in MT, then, with the syntactic knowledge in LT, the referent of the substitution *one* in the second sentence will be found to be that of *axe* in the NP of the first sentence. In the same way, the referent of *does* will be recognized as that of *knows* in the first sentence. An example of ellipsis is as follows,

- (3)' a. $\{s\{_{NP}Joan}\{_{VP}brought\{_{NP}some\ carnations}\}\}$
 and $\{s\{_{NP}Catherine}\{_{VP}\phi\{_{NP}some\ sweet\ peas}\}\}\}$

In this case, the structure of the first sentence will be copied in MT, then the referent of ϕ in the second sentence will be found as *brought* in the VP of the first sentence.

Thus each inner representation pursues its own memory cycle in the process of discourse understanding ; especially the cases of substitution and ellipsis show the importance of the memory of syntactic structure itself in the process.

3.1.2. Second, we will argue that analogous imagery representation along with other representations plays crucial part in discourse understanding. Observe the following examples,

- (6) a. In an attempt to organize the possible answers, I propose to put them [progress in mathematics] into three classes: concepts, explosions, and developments

The first class consists of new concepts By an explosion I mean a peace of mathematical progress

The third proposed class consists of the deep and in some cases even breathtaking developments [P. R. Halmos. 1990. *Has progress in Mathematics Slowed Down?*]

- b. It [the IDEATIONAL component] has two parts to it, the the experiential and the logical, the former being more directly concerned with the representation of experience, of the 'context of culture' in Malinowski's term, while the latter expresses the abstract logical relations which derive only indirectly from experience. [Halliday & Hassan 1976:26]

The cohesive relations in (6) are analysed below.

- (6)' a. [S1]: three classes: concepts, explosions, and developments.

[S2]: The first class

[S3]: By an explosion

[S4]: The third proposed class

- b. [S1]: two parts to it, the experiential and the logical.

[S2]: the former,

[S3]: while the latter

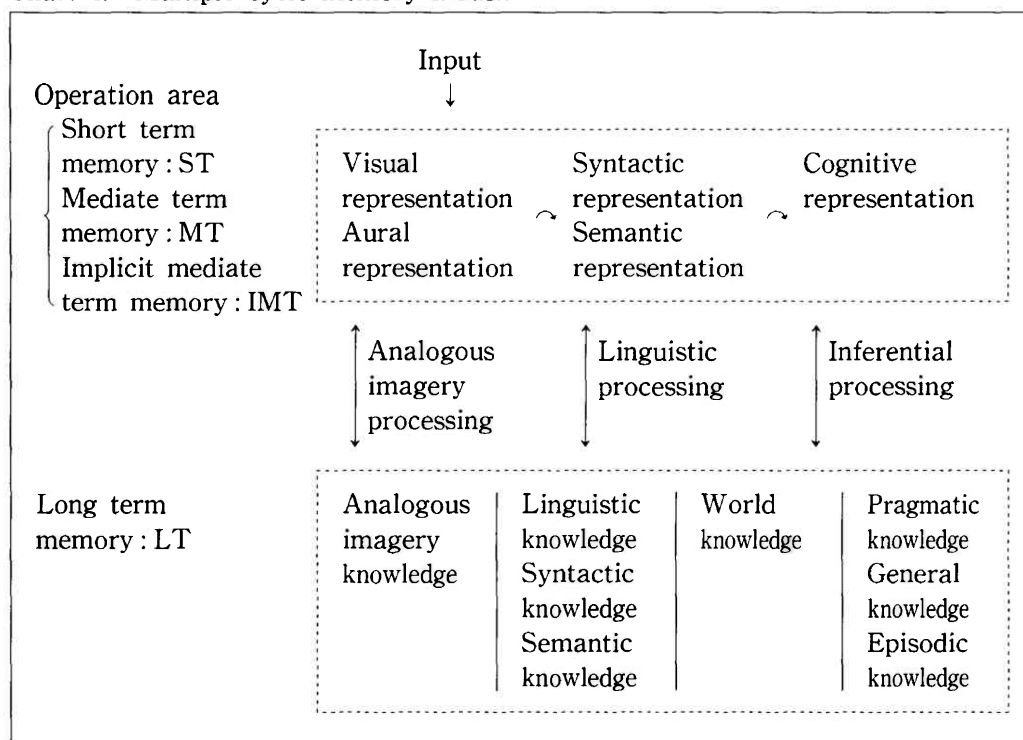
Is the cohesion hold only by lexical cohesion of *explosion* in 6'a, and by conjunction of *while* in 6'b? We found stronger cohesive device in 6; in 6'a, the three classes in linear order (concepts explosions, and developments) are referred back by ordinal expressions (*The first* in [S2] and *The third* in [S4]), in 6'b, the two parts in linear order (the experiential, the logical) are referred back by ordinal expressions (*the former* in [S2] and *the latter* in [S3])³.

These observations show that analogous imagery representation is also copied in MT and works during discourse processing.

3.2. Multiple cycle memory model.

We will show a new model which can deal with the problems discussed in 3.1, and call it 'multiple cycle memory model' as in Chart 4.

Chart 4. Multiple cycle memory model.



There are three distinct points in this model; the operation area is spread through ST, MT, and IMT, the analogous imagery processing is incorporated, and the operation arrows point at both directions. The first point means that the memory cycle is incorporated in multiple processing. The second point stresses the importance of visual and aural information in discourse understanding. The visual image of the title of some article, for example, might be a good example (cf. Quirk 1988). The third point implies that all the representations including linguistic ones have right to remain in LT and work as they are.

4. Conclusion.

Language has been treated and studied as a device for securing which holds the precision of the information processing of human beings. In this frame of mind,

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most scholars have mainly concerned with the content of information based on the referents of words, and as the result, the study of analogous imagery information processing, which hinges on the memory of word(-form)s themselves, has been totally neglected, or, at least, left out of scholastic discussion at the academic level. This is a serious case of oversight on the part of linguists. To my thinking, the best way to remedy this state of things is to incorporate the idea of analogous imagery information processing into memory model, so as to pave the way for grasping and analyzing the whole range of devices of cohesion adequately and successfully.

Notes

1. An earlier version of this paper was presented in July (1993) at the poster session of the 4th International Pragmatics Conference. I would like to thank Prof. Yoshinobu Mōri for many valuable comments.
2. Cohesion is defined in Yamanashi 1990 as not only formal device to connect discourse but semantic or logical one. Halliday & Hassan 1976 studied the former.
3. Other languages, too, have same sort of devices. Examples in Japanese are shown as follows:
 - (a) zensha 'the former', koosha 'the latter'
 - (b) joukino 'above mentioned', kakino 'mentioned below'
 - (c) migi 'mentioned in the right', sakino 'mentioned in the left'

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