

Montague Grammatical Analysis of Japanese Case Particles

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1 Introduction

The Montague Grammar for English and other Indo-European languages in the literature is based on the subject-predicate relation, which has been the tradition since Aristotle in the Western language analysis. In this sense, for example, an object and a transitive verb are part of a verb phrase, that is, of a predicate, and the types of a transitive verb and of an object are assigned after the type of predicate (verb phrase) is fixed. When we try to construct categorial grammar and denotational semantics following this tradition, we meet the following deficiencies;

- The type structure for transitive verbs and objects, hence their denotations, becomes very complicated. For example, the type for transitive verbs is;

$$((e \rightarrow t) \rightarrow t) \rightarrow (e \rightarrow t).$$

- In order to get an appropriate type for a sentence within the ordinary categorial grammar, we first concatenate a transitive verb with an object and then a subject with the result of the first concatenation. Hence, the resulting grammar becomes very much word-order sensitive.

It is easily seen that this kind of operation is not suitable for languages which have word-order flexibility like Japanese, where the following sentences are equivalent in meaning “I ate a cake.”;

- (1) a. Watashi ga cake wo tabeta.
I NOM cake ACC ate
b. Cake wo watashi ga tabeta.
cake ACC I NOM ate

We employ the following notational convention in this paper. To each example sentence of Japanese, we append a gloss which shows the corresponding English expression to each Japanese word and an English translation. Within our examples of Japanese, there are expressions which lack corresponding English expressions. For these items, we use the following symbols: for ga (nominative case marker), NOM; for wo (accusative case marker), ACC; for ni (dative case marker), DAT; for de (locative case marker), LOC; for kara (ablative case marker), ABL; for to (comitative case marker), COM; for de (instrumental case marker), INS; for no (genitive case marker), GEN; and for wa (topic marker), TOP.

In this paper we shall construct a Montague Grammar which covers such a word order flexibility. We consider seven particles as essential which have long been assumed to be "case particles" by traditional grammarians[2] and assume that each of these has an unique case and hence can be treated uniquely (though at the end of this paper we will point out some of these have several cases). This means that each case is of the same importance in relation to the related verb in Japanese, while the traditional subject– predicate based analysis takes it for granted that the subject is of a special importance and the other cases are only parts of the predicate. This equivalent treatment of cases with respect to the verb naturally leads us to a simplified typing rules in the categorial grammar level; in fact, as a consequence of the equivalent treatment of cases, the type of terms (common nouns, proper names, intransitive verbs, adjectives) and transitive verbs, for example, becomes basically the same, i.e., the type of $e \rightarrow t$.

Sakai[6] also set up a case-grammar based Montague grammar for Japanese. His work is considered as a pioneering work in this field. He considers five argument places for each predicate (in his theory, "sentence"). The five cases, as in our theory, are in the same relation with respect to the predicate. However, in his framework, a sentence which lacks at least one case in its argument is not recognized as a sentence in an ordinary sense, i.e, it is not an object of type t . Consequently, in Sakai's theory, most sentences of Japanese do not have type t . This means that there are many sentences in Japanese the truth value of which cannot be decided. On the other hand, in our theory, we introduce an operation, called *completion*, which changes an incomplete sentence into a complete one, hence has a type t . Other than the treatment of case particles, there are two important differences between Sakai[6] and our theory. The first one is concerning genitive (or possessive) case marker "no". Sakai[6] considers "no" as being different from other case particles and deals with it as a kind of predicate, i.e., translates it into "shoyuusuru (own)" in a logical language. On the other hand, in our theory, "no" behaves as a case marker with respect to nouns. The other difference is about a modal particle "wa". Sakai[6] treats "wa" in terms of ordinary necessity operator. His definition of "wa" turns out to be counterintuitive according to our intuition of Japanese. In the following, we introduce special modality for "wa". Throughout the subsequent discussions, we argue for the advantage of our theory, sometimes with comparisons to Sakai[6]'s work.

2 Japanese Case Particles

Case particles, which mark case relationships between nouns and predicates, play important roles in the Mongorean group languages like Japanese, where the word order is relatively flexible. For this reason, treatment of case particles should constitute an essential part within a grammar of Japanese. In this section we present a Montague grammatical treatment of case particles in Japanese. For the construction of a grammar of Japanese concerning the categorial grammar, the translation into a formal language (typed lambda calculi), and the interpretation into a model theoretic denotational semantics, we follow the convention introduced in Montague[3]. In addition, we introduce several rules in order to deal with some peculiarities of Japanese. We introduce seven case

particles¹ which will be the basis of the study in this paper. There may well be a possibility that a case particle expresses more than one case. We ignore this possibility at present for the sake of the ease of discussion and assume every case particle is used to express only one case (cf. Section 3). The following shows items which correspond to each case relationship. The number after each item shows the argument place of the term with each particle for verbs.

1. ga (nominative case): 1
2. wo (accusative case): 2
3. ni, de (locative case): 3
4. he, ni (dative case): 4
5. kara (ablative case): 5
6. to (committative case): 6
7. de (instrumental case): 7

Here we assume that each verb has all or part of these cases. Within our fragment being introduced below, we make distinctions among verbs by putting these numbers after each verb. For example, a verb which takes only a nominative case, e.g. utsukushii (be beautiful) can be described as V_1 . Verbs which take nominative, locative and ablative case can be expressed by $V_{1,3,5}$. And so on and so forth.

Now, we give a minimal fragment necessary of Montague Grammar for Japanese including the case particles and their semantic types.

Definition 1 *A Fragment of Japanese*

1. *Term*

- (a) *Common nouns (CN)* $\equiv e \rightarrow t$: inu (dog),...
- (b) *Proper Names (PN)* $\equiv e \rightarrow t$: Taro, Hanako,...
- (c) *Pronouns (Pron)* $\equiv e \rightarrow t$: watashi (I, my, me), kare (he, his, him),...

2. *Verb*

- (a) V_1 (*Adjective*) $\equiv e \rightarrow t$: utsukushii (be beautiful), kashikoi (be wise),...
- (b) $V_{1,2}$ $\equiv e \times e \rightarrow t$: naguru (hit),...
- (c) $V_{1,2,3}$ $\equiv e \times e \times e \rightarrow t$: taberu (eat),...
- (d) $V_{1,\dots,7}$ $\equiv e \times e \times e \times e \times e \times e \times e \rightarrow t$: hakobu (bring),...
- (e) *A type of a verb which has only cases 1,3,6 (and lacks 2,4,5,7) is*
 $V_{1,*3,*6,*}$ $\equiv e \times e \times e \rightarrow t$: deau (meet),...

One can consider other types of V, in the same way as above.

3. *Case Particle* $\equiv Term \times Term \times e \times \dots \times e \rightarrow t$: ga, wo, ni, he, kara, to, de.

The following shows translations into λ terms;

- $\text{taro} = \lambda x.(x = \text{taro})$: proper name
- $\text{inu} = \lambda x.\text{inu}(x)$: common noun
- $\text{cake} = \lambda x.\text{cake}(x)$: common noun
- $\text{utsukushii} = \lambda x.\text{utsukushii}(x)$: adjective
- $\text{taberu} = \lambda xyz.\text{taberu}(x, y, z)$: $V_{1,2,3}$
- n-case particle = $\lambda PQ\lambda x_1, \dots, x_{n-1}, x_{n+1}, \dots, x_7\exists x_n[P(x_n) \wedge Q(x_1, \dots, x_7)]$

Montague Grammar for Japanese that we have constructed has several features which should be distinguished from Montague Grammar for English. As we have shown above, the word order flexibility of Japanese enables us to construct Montague Grammar without the restriction we have made for the type structure of Categorical Grammar for English. It should be also noted here that the translation of proper names in Japanese is quite different from that of English. This is because, unlike English, Japanese lacks determiners or determiner-like expressions. In Japanese, the resulting translation and interpretation of proper names is almost the same as that of common nouns. The other feature of Japanese is that the number of arguments for a predicate is not fixed. It frequently happens in Japanese that a predicate which in one context has one argument has two in another context. This is closely related to the fact that in Japanese, the distinction between transitive and intransitive verbs is not so rigid as in European languages. Here we assume that all verbs have seven arguments ideally, except for the adjectives or adjectival-verbs which have only one (nominative) argument. And in this paper, Japanese adjectives and adjective-verbs are treated as such special cases of verbs that have the nominative argument only. This implies that Japanese will not have type t (the type for sentences) unless seven argument places of a predicate are filled with appropriate arguments. Since most sentences do not have type t (the type of complete sentence), we need to consider an operation which makes an incomplete sentence complete when some cases of a verb do not appear, which happens very often in Japanese. We define the following operation, called *completion*, which forces us to make an incomplete sentence a complete one;

Definition 2 *Completion of an Incomplete Sentence*

When a term is an incomplete sentence of the form $\lambda x_1, \dots, x_n A x_1, \dots, x_n$ (where A is a n -place predicate), then one can translate it into a complete sentence of the form $\exists x_1, \dots, x_n A x_1, \dots, x_n$ (when the predication is about a particular object) or $\forall x_1, \dots, x_n A x_1, \dots, x_n$ (when the predication is about a general nature of an object).

Now we derive the following translations from examples below.

- (2) inu ga cake wo taberu.
 dog NOM cake ACC eat
 “A dog eats a cake.”
- inu ga = $\lambda Q \lambda \bar{y} \exists x (inu(x) \wedge Q(x, \bar{y}))$
 - cake wo taberu = $\lambda x \lambda z \lambda \bar{w} \exists y (cake(y) \wedge taberu(x, y, z))$
 - inu ga cake wo taberu = $\lambda z \lambda \bar{w} \exists y \exists x (inu(x) \wedge cake(y) \wedge taberu(x, y, z))$
- Now by the completion it becomes
 $\exists \bar{w} \exists z \exists x \exists y (inu(x) \wedge cake(y) \wedge taberu(x, y, z))$
 This is logically equivalent to
 $\exists z \exists x \exists y (inu(x) \wedge cake(y) \wedge taberu(x, y, z))$

The following translation shows that we can get the uniform interpretation independent of the order of application.

- (3) cake wo inu ga taberu.
 cake ACC dog NOM eat
 “A dog eats a cake.”
- cake wo = $\lambda Q \lambda x \lambda \bar{w} \exists y (cake(y) \wedge Q(x, y, \bar{w}))$
 - inu ga taberu = $\lambda y \lambda z \lambda \bar{w} \exists x (inu(x) \wedge taberu(x, y, z))$
 - cake wo inu ga taberu = $\lambda z \lambda \bar{w} \exists x \exists y (cake(y) \wedge inu(x) \wedge taberu(x, y, z))$
- Now by the completion it becomes
 $\exists \bar{w} \exists z \exists x \exists y (inu(x) \wedge cake(y) \wedge taberu(x, y, z))$
 This is logically equivalent to
 $\exists z \exists x \exists y (inu(x) \wedge cake(y) \wedge taberu(x, y, z))$

The above shows that an incomplete sentence “inu ga cake wo taberu (A dog eats a cake)” is considered as a complete sentence “inu ga arubasho de cake wo taberu (a dog eats a cake at some place)” by the *completion*.

Next, we define the operation which forms an adjectival form of an incomplete sentence. Japanese does not have a grammatical device such as “relative pronouns” in European languages; instead, in Japanese an incomplete sentence (which corresponds to a relative noun clause) is directly attached in front of a noun. The following explains this mechanism.

Definition 3 *Adjectival Form of an Incomplete Sentence*

When a term is an incomplete sentence of the form $\lambda x.Ax$ (where A is a predicate, i.e. of type $e \rightarrow t$) and $\lambda x.Bx$ is a translation of a noun, then one can use the incomplete sentence as an adjectival form by concatenating with the noun, which becomes of the form $\lambda x.(Ax \wedge Bx)$.

The following is an example of “Cake wo taberu inu” (a dog which eats a cake).

- (4) Cake wo taberu inu
 cake ACC eat dog
 “a dog which eats a cake”
- a. $inu = \lambda x.inu(x)$
 - b. $cake = \lambda x.cake(x)$
 - c. $taberu = \lambda xyz.taberu(x, y, z)$
 - d. $wo = \lambda PQ\lambda x\lambda \bar{w}\exists y(P(y) \wedge Q(x, y, \bar{w}))$
 - e. $cake\ wo\ taberu = \lambda x\lambda z\lambda \bar{w}\exists y(cake(y) \wedge taberu(x, y, z))$
 - f. $cake\ wo\ taberu\ inu = \lambda x\lambda z\exists y(cake(y) \wedge taberu(x, y, z) \wedge inu(x))$

The reader is invited to write “Inu ga taberu cake” (a cake which a dog eats.):

- (5) Inu ga taberu cake
 dog NOM eat cake
 “a cake which a dog eats”
- a. $inu = \lambda x.inu(x)$
 - b. $ga = \lambda PQ\lambda y\exists x(P(x) \wedge Q(x, y))$
 - c. $taberu = \lambda xyz.taberu(x, y, z)$
 - d. $cake = \lambda x.cake(x)$
 - e. $inu\ ga\ taberu = \lambda y\lambda z\exists x(inu(x) \wedge taberu(x, y, z))$
 - f. $inu\ ga\ taberu\ cake = \lambda y\lambda z\exists x(inu(x) \wedge taberu(x, y, z) \wedge cake(y))$

A special case of this rule is the following adnominal use of adjectives.

- (6) kashikoi inu
 wise dog
 “a wise dog”
- a. $kashikoi = \lambda x.kashikoi(x)$
 - b. $inu = \lambda x.inu(x)$
 - c. $kashikoi\ inu = \lambda x(kashikoi(x) \wedge inu(x))$

3 Adjectival Case Particle “no”

Besides the above case particles with respect to a verb, there is one more case particle, “no”, which marks case relationships with respect to a noun. It has been acknowledged uncontroversially that “no” represents a unique case, which is called the “possessive case”. From the logical point of view, we propose to admit the seven argument places for a noun, as well. In this section, we propose a treatment of adjectival case in a uniform way with our theory of adverbial cases. Here, the crucial difference between an adverbial case and an adjectival

case in modern Japanese is that for the adverbial case we use distinct particles for marking different cases, while for the adjectival case, we use only one particle “no” to express all the seven cases. In fact, it is easy to find out various different cases expressed by “no” in modern Japanese. It is also very natural to consider various different cases for “no” from the viewpoint of its historical development. It has been observed by Shibatani[7] that in Heian era, “no” used to express various case relationships as an adverbial as well as an adjectival case marker. Afterwards, with the advent of other case particles as *ga*, *wo*, *ni* etc., the various functions of “no” was replaced by them and disappeared. From this observation, it is reasonable to consider that the various functions of “no” only remains in adjectival form in modern Japanese. The following examples show that there are various case relationships expressed by “no”.

- (7) 1. *josei no sakka*: nominative case
female GEN writer
“a writer who is female” or “a female writer”
2. *kodomo no sewa*: accusative case
child GEN care
“to care a child” or “a care of a child”
3. *Kyoto no sakura*: locative case
Kyoto GEN cherryblossom
“cherryblossoms in Kyoto”
4. *inu no esa*: dative case
dog GEN food
“food for the dog”
5. *tomodachi no okurimono*: ablative case
friend GEN gift
“a gift from a friend (of mine)”
6. *Anata no kodomo*: comitative case
Anata GEN child
“a child made with you” or “a child born between you and me”
7. *tegaki no tegami*: instrumental case
written by hand GEN letter
“a letter by hand-writing” or “a letter written by hand”

It is apparent for a native speaker of Japanese each “no” in these examples contains more informations than merely “genitive case”. In the first example, *josei no sakka* “a female writer”, *josei* “a female” and *sakka* “a writer” is in the relation of *de aru* “being”, hence we regard “no” in this case as nominative case. In *kodomo no sewa* “a care of a child”(a care for a child, in usual English), *kodomo* “children” becomes the object of care for a speaker, which is usually expressed by accusative case marker “*wo*” in Japanese. The third example shows “kyoto” is the place where the cherryblossoms are located, which is expressed by locative case. In the fourth example, *inu no esa* “food for the dog”, *inu* “the dog” is a goal of sending food and hence “no” becomes dative. In *tomodachi no okurimono* “the gift of a friend of mine”, *tomodachi* “a friend from a friend of mine” is a sender of the gift. This is “ablative” case. For the example six,

Anata no kodomo, we have a reading of “a child born between you and me” and this reading can always be expressed by “to”, comitative case marker. We can find out a reading of “instrumental” case in examples like *tegaki no tegami* “a letter written by hand”, where *tegaki* “hand-written” expresses the way how the letter is written. Thus all of these examples show that we can define “no” as being able to express possibly every case relationships between nouns. In analogy with interpretation for adjectival case particles, we interpret “no” by translating it into the following. “No” of the n-th case is translated as;

$$\bullet \text{ no} = \lambda PQ \lambda x_1, \dots, x_{n-1}, x_{n+1}, \dots, x_7 \exists x_n [P(x_n) \wedge Q(x_1, \dots, x_7)]$$

In general, “no” phrase is ambiguous. For example, in (7)5, “no” in *tomodachi no okurimono* have readings of *tomodachi karano okurimono* “a present from a friend of mine” and of *tomodachi heno okurimono* “a present for a friend of mine”. This kind of ambiguity is a natural consequence of our theory for “no”, i.e., “no” expresses possibly seven case relationships with respect to nouns. In order to remove the ambiguity, we sometimes use a combined form of an adverbial case particle and a “no”. Here, the additional adverbial particle is considered to assist the meaning of “no”. In the above example, *kara-no* stands for ablative case (which consists of adverbial case particle “kara” of case 5 and “no”), i.e., “a gift from a friend of mine” and *he-no* stands for dative case (which consists of adverbial case particle “he” of case 4 and “no”), “a gift for a friend of mine”. We propose to consider these combined forms as independent case particles with respect to nouns, rather than combined forms which are composed of two case particles, an adverbial case particle (i.e., “kara” and “he”, in the above example) and an adjectival case particle (“no”). Thus the translation and the type for a combined form is the same as that for “no”.

The following is an example of the translation for “no” phrase;

- (8) inu no esa
 dog GEN food
 “food for the dog”
- a. $\text{inu} = \lambda x_1 x_3 \text{inu}(x_1, *, x_3, *, *, *, *)$
 - b. $\text{esa} = \lambda x_1 x_3 x_4 \text{esa}(x_1, *, x_3, x_4, *, *, *)$
 - c. $\text{inu no esa} = \lambda x_3 y_1 y_3 \exists z (\text{inu}(z, *, x_3, *, *, *, *) \wedge \text{esa}(y_1, *, y_3, z, *, *, *))$
 $= \lambda y_1 \exists z x_3 y_3 (\text{inu}(z, x_3) \wedge \text{esa}(y_1, y_3, z))$

The following shows a translation for adverbial case and adjectival case.

- (9) Taro ga kyoto no josei no ninki no sakka to atta.
 taro NOM kyoto GEN female GEN famous GEN writer COM met
 “Taro met a famous female writer who is living in Kyoto.”
- a. taro = $\lambda x(x = taro)$
 - b. kyoto = $\lambda y_1 kyoto(y_1)$
 - c. josei = $\lambda z_1 josei(z_1)$
 - d. ninki = $\lambda u_1, u_3, u_4 ninki(u_1, u_3, u_4)$
 - e. sakka = $\lambda z_1, z_3, z_7 sakka(z_1, z_3, z_7)$
 - f. atta = $\lambda x, z_1 atta(x, z_1)$
 - g. taro ga kyoto no josei no ninki no sakka to atta (with completion)
 = $\exists x y_1 z_1 z_7 u_1 u_3 u_4 (x = taro \wedge kyoto(y_1) \wedge josei(z_1)$
 $\wedge ninki(z_1, u_3, u_4) \wedge sakka(z_1, *, y_1, *, *, *, z_7) \wedge atta(x, *, *, *, *, z_1, *))$

4 Case Particles and Modal Particles

In Japanese, we have other kinds of particles whose functions are more than expressing case relationships. The oldest form of these can be seen in Nara and Heian period, where they are called “kakari-joshi” (this name comes from their functions within sentences, namely, “kakari-musubi”, an operation which changes the form of “yoogen” (predicates) into a particular form). Although these functions are disappeared in modern Japanese, we still have devices whose semantic functions within sentences are almost the same as “kakari-joshi” in old Japanese. One thing we can point out as an essential semantical difference between case particles and these particles is that the presence of the latter affects moods of sentences. In this paper, following Yamada[10], we will call them “modal particles”. There are several particles that can be called “modal particles”². Syntactically, these particles behave in various ways, i.e., appearing before and after case particles, among sentences with no case particles, etc.. As their syntactic behaviours vary, so do their semantics. In this paper, we confine ourselves to a modal particle “wa”, the nature of which has been one of the most discussed topic in the literature³, and present a treatment of it within denotational semantics. A general theory of Japanese modal particles will be given in our subsequent paper.

4.1 “wa” as Sentential Topic

Particle “wa” has been considered as a topic marker [1]. Also, it has been widely acknowledged that “wa” as a topic marker has basically two usages[9]:

1. contrastive or comparative use
2. thematic or resumptive use

Our goal in this section is to make clear the nature of “wa” which constitutes the base for these two uses. In order to do this, we need to clarify what these

two uses mean. Consider the followings;

- (10) a. Kinoo wa ame de kyoo wa hare da.
yesterday TOP rain and today TOP fine
'It was rainy yesterday and it is fine today.'
- b. Migi wa ginkoo de hidari wa kyookai desu.
right TOP bank and left TOP church
'On the right you will see a bank and on the left you will see a church.'
- (11) a. Boku wa tensai da.
I TOP genius
'I am a genius.'
- b. Sora wa aoi.
sky TOP blue
'The sky is blue.'

Sentences of (10) are usually called "contrastive" and those of (11) "thematic". When we observe "wa" sentences of contrastive use, we soon notice the followings;

- When a sentence of the form a 'X wa Z' has contrastive meaning, there usually appears another "wa" phrase in conjunction with the first one, as in (10).
- The contrastive meaning of 'X wa Z' has often been raised by the lexical property of "X", which is usually understood to have its contrastive counterpart, e.g., migi (right) vs. hidari (left), kinoo (yesterday) vs. kyoo (today) vs. ashita (tomorrow), otoko (male) vs. onna (female), etc.,

Contrastive meanings of (10) depend on their constructions, i.e., they are the form of 'X wa Z de Y wa W da' and every sentence in (11) can be used contrastively if we posit it in certain contexts. From these observations we assume that the contrastive use of "wa" is not the meaning inherently attached to "wa" itself, but something that arises from environmental causes. In other words, we can say that any "wa" sentence is a possible candidate to have "contrastive" nuance within a certain context.

The thematic use is such that "wa" picks up a term phrase as a theme and describe a property of it by a predicate phrase. In the next section we look at several uses of "wa" besides these two and treat these in terms of the notion "modality" which can give a uniform meaning shared by all the possible uses of "wa".

4.2 Modality of “wa”

When we look at sentences of the form “X wa Z”, we notice the following features;

- “Wa” supplies information about a familiar subject (Kuno[1], Sakai[6]).
e.g., Kaki wa hiroshima ga honba da. ‘As for oysters, Hiroshima is the best place.’
- “Wa” presents a theme in a text and awakens expectation for its explanation.
e.g., Boku wa kanji da. ‘I am a chairman.’
- “Wa” has a connotation of ‘mono-da’, when the predicate phrase is a property-denoting expression and the whole sentence denotes to express a permanent state (Teramura[9], Shirai[8]). e.g., Yuki wa shiroi. ‘Snow is white.’
- “Wa” is used to express a fact which remains in one’s mind as an accepted conception. (Sakai[6])
e.g., Nihon no shuto wa Kyoto datta. ‘The capital of Japan was situated in Kyoto.’
- Sentences with “wa” can express personal feelings or observations of speakers.
e.g., Taro wa tetsugakusha da. ‘Taro is a philosopher’. Kimi wa ut-sukushii. ‘You are beautiful’.

Sakai[6] introduces the following translation for sentences with “wa”;

$$* X \text{ wa } A \equiv \Box A(X)$$

As for the interpretation of a necessity operator, Sakai[6] argues that the modal mood of necessity of “wa” is different from logical necessity which is generally understood in the European sense. According to him, the necessity of “wa” sentence contains the notion of well-knownness or familiarity with the subject matter. This notion corresponds to what Shirai[8] calls “mono-property”. Shirai[8] asserts that “wa” phrase is necessarily true on a “mono” world, i.e., the world constructed by norms or principles in our culture. Here “mono” is not to be understood as an object but something which corresponds to norms or principles in our culture. For example, by *Yuki wa shiroi* (snow TOP white, ‘Snow is white.’), we express the necessity of the proposition, *Snow is white*, not in a real world, but in a world which is constructed by norms or principles in our culture. Sakai[6] does not introduce any special modality in order to describe this “mono” interpretation. His translation only asserts that every “wa” sentence is logically true. The denotation of this translation according to a naive modal system like S5 says that $A(X)$ is true for every possible world. This interpretation for “wa” is too strong for our intuition of Japanese. For example, consider *Zou wa hana ga nagai* (elephant TOP nose NOM long, ‘An elephant has a long nose.’). According to the natural interpretation, this sentence is false if there is a world where an elephant has a short nose. But according to our

intuition of Japanese, this sentence is not false even if we know an existence of a world where an elephant has a short nose. It seems that what Sakai[6] intends to do is to incorporate the peculiar modality of “wa”, from which the connotation of “mono” arises and which he considers the essential property of “wa”. We regard this “mono” use as just one use of several uses of “wa” and give no priority over the other uses as those we have shown above. Our proposal here is to describe a denotation which is common for several different uses of “wa”. This approach is very natural if we stick to the basic principle of denotational semantics, i.e., ‘An expression has a unique denotation.’ For this purpose, we introduce the following translation for sentences with “wa”;

$$A \text{ wa } B \equiv \Box_A(\forall x B(x))$$

Here, $A \text{ wa } B$ is said to be true iff in every possible world *concerning* A , every individual variable x has the property B . According to this translation, the interpretation for our example, *Taro wa tetsugakusha da* (Taro TOP philosopher be, ‘Taro is a philosopher.’) is;

$$(\text{Taro wa tetsugakusha da}) \equiv \Box_{\text{taro}}(\forall x \text{ tetsugakusha } (x))$$

Thus, *Taro wa tetsugakusha da* is true iff in every possible world concerning Taro, every x is a philosopher. Now we can express how this interpretation can be the basis of several uses of a sentence.

Differences of uses (thematic, contrastive, subjective, etc.,) correspond to assignments of the actual denotation (sets), which can be done outside the denotational semantics, namely, the second level of the semantic theory⁴. As we have already seen, in our translation for “Taro wa tetsugakusha da”, the assigned denotation of “the domain of Taro”, expressed by a modal operator, refers to different possible worlds. When the domain of (taro)* is taken as the “real” domain associated with real Taro, the “wa” sentence expresses a real fact and the use is understood as a typical use of the thematic “wa”. When the domain of Taro is assigned as a subjective set in the speaker’s mind, or some specific subset of the real Taro’s domain which is cut off or is focused on by the speaker’s intention, the “wa” sentence gets more personal or subjective meaning; i.e., even if Taro is not really *tetsugakusha*, the *Taro wa tetsugakusha da* becomes true on the specific subjective domain or the restricted domain for Taro, e.g., a domain where Taro is wise, likes reading books, looks pale, dislikes chasing girls, etc.. Finally, we can describe the situation which gives the effect of the contrastive use as follows; the domain of Taro is drawn or described by the “wa”-modal operator when some other domains, e.g., a domain of Hanako, already exists explicitly or implicitly (by the denotational assignments of the sentences of the discourse or of the context of conversations), then it means the domain of Taro exists besides another domain. These distinct denotations are understood to be “contrastive” when we look at them.

5 Conclusion

In the first section, we presented a categorial grammar of Japanese sentences, taking word-order flexibility into serious consideration. We extended our theory of adverbial case particles to a that of genitive (or possessive) case marker “no”, in a uniform way. It was shown that “no” is also used to express seven different cases as adjectival case marker. As we showed, our translation explains the meaning of an incomplete sentence and the meaning of the adjective use of an incomplete sentence in a simple and uniform way.

A Japanese language is rich in having devices to describe things other than reality. The particle “wa” is one of such devices. We presented a denotational semantics for “wa”, in order to compare the semantic feature of modal particles with that of case particles. We introduced a new modality to interpret “wa”. In our subsequent paper we shall extend this idea to other modal particles.

Notes

¹Here, we are following Mikami[2], who assumes the following seven cases as essential.

²For a specific information about these, see Teramura[9].

³See Mikami[2].

⁴See Okada-Watanabe[5], Ch.3.4.

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