

THE SYNTACTIC PROCESSING OF PARTICLES IN JAPANESE SPOKEN LANGUAGE

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Abstract

Particles fulfill several distinct central roles in the Japanese language. They can mark arguments as well as adjuncts, can be functional or have semantic functions. There is, however, no straightforward matching from particles to functions, as, e.g., *ga* can mark the subject, the object or an adjunct of a sentence. Particles can cooccur. Verbal arguments that could be identified by particles can be eliminated in the Japanese sentence. And finally, in spoken language particles are often omitted. A proper treatment of particles is thus necessary to make an analysis of Japanese sentences possible. Our treatment is based on an empirical investigation of 800 dialogues. We set up a type hierarchy of particles motivated by their subcategorizational and modificational behaviour. This type hierarchy is part of the Japanese syntax in VERBMOBIL.

1 Introduction

The treatment of particles is essential for the processing of the Japanese language for two reasons. The first reason is that these are the words that occur most frequently. The second reason is that particles have various central functions in the Japanese syntax: case particles mark subcategorized verbal arguments, postpositions mark adjuncts and have semantic attributes, topic particles mark topicalized phrases and *no* marks an attributive nominal adjunct. Their treatment is difficult for three reasons: 1) despite their central position in Japanese syntax the omission of particles occurs quite often in spoken language. 2) One particle can fulfill more than one function. 3) Particles can cooccur, but not in an arbitrary way.

In order to set up a grammar that accounts for a larger amount of spoken language, a comprehensive investigation of Japanese particles is thus necessary. Such a comprehensive investigation of Japanese particles was missing up to now. Two kinds of solutions have previously been proposed: (1) the particles are divided into case particles and postpositions. The latter build the heads of their phrases, while the former do not (cf. [6], [12]). (2) All kinds of particles build the head of their phrases and have the same lexical structure (cf. [1]). Both kinds of analyses lead to problems: if postpositions are heads, while case particles are nonheads, a sufficient treatment of those cases where two or three particles occur sequentially is not possible, as we will show. If on the other hand there is no distinction of particles, it is not possible to encode their different behaviour in subcategorization and modification. We carried out an empirical investigation of cooccurrences of particles in Japanese spoken language. As a result, we could set up restrictions for 25 particles. We show that the problem is essentially based at the lexical level. Instead of assuming different phrase structure rules we state a type hierarchy of Japanese particles. This makes a uniform treatment of phrase structure as well as a differentiation of subcategorization patterns possible. We therefore adopt the 'all-head' analysis, but extend it by a type hierarchy in order to be able to differentiate between the particles. Our analysis is based on 800 Japanese dialogues of the VERBMOBIL data concerning appointment scheduling.

2 The Type Hierarchy of Japanese Particles

Japanese noun phrases can be modified by more than one particle at a time. There are many examples in our data where two or three particles occur sequentially. On the one hand, this phenomenon must be accounted for in order to attain a correct processing of the data. On the other hand, the discrimination of particles is

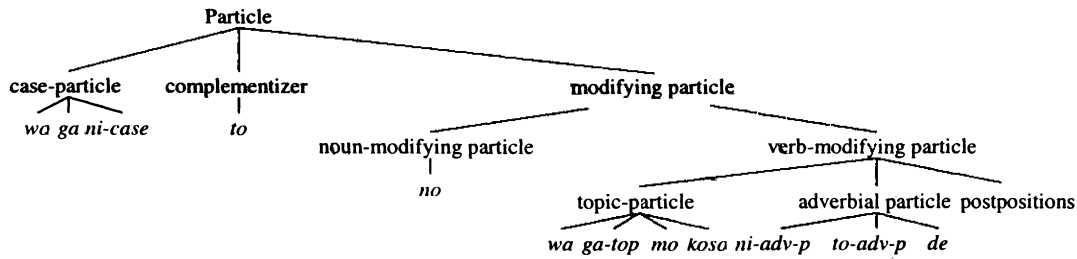


Figure 1: Type Hierarchy of Japanese Particles. Postpositions include *e*, *naNka*, *sonota*, *tomo*, *kara*, *made*, *soshite*, *nado*, *bakari*, *igai*, *yoru*, *toshite*, *toshimashite*, *nitsuite*, *nikaNshite* and *nikakete*

motivated by their modificational and subcategorizational behaviour. We carried out an empirical analysis, based on our dialogue data. Table 1 shows the frequency of cooccurrence of two particles in the dialogue data. There is a tendency to avoid the cooccurrence of particles with the same phonology, even if it is possible in principal in some cases. The reason is obvious: such sentences are difficult to understand.

left↓/right→	ga	wo	ni	de	e	kara	made	no	wa	mo	naNka	to
ga	0	0	0	0	0	0	0	0	0	0	0	0
wo	0	0	0	0	0	0	0	0	0	0	0	3
ni	0	0	0	19	0	0	0	0	137	49	0	15
de	2	0	0	0	0	0	0	14	158	241	0	30
e	0	0	0	1	0	0	0	4	0	0	0	0
kara	23	0	30	81	0	0	0	34	69	12	0	123
made	17	1	66	32	0	0	0	40	63	1	0	79
no	64	9	1	2249	0	0	0	0	287	11	0	4
wa	0	0	0	2	0	0	0	0	0	0	1	3
mo	0	0	0	0	0	0	0	0	0	0	0	0
naNka	3	0	0	1	0	0	0	0	30	0	0	0
to	0	3	0	1	0	0	0	14	17	58	0	0
toshite	0	0	0	0	0	0	0	0	36	15	0	0
toshimashite	0	0	0	0	0	0	0	0	15	0	0	0

Table 1: Cooccurrence of 2 Particles in the 800 Dialogues

[4] treats *wa*, *ga*, *wo*, *ni*, *de*, *to*, *made*, *kara* and *ya* as ‘particles’. They are divided into those that are in the deep structure and those that are introduced through transformations. An example for the former is *kara*. examples for the latter are *ga*(SBJ), *wo*(OBJ), *ga*(OBJ) and *ni*(OBJ2). [1] assigns all particles the part-of-speech P. Examples are *ga*, *wo*, *ni*, *no*, *de*, *e*, *kara* and *made*. All particles are heads of their phrases. Verbal arguments get a grammatical relation [GR OBJ/SBJ]. In [2] the part-of-speech class P contains only *ga*, *wo* and *ni*. [12] defines postpositions and case particles such that postpositions are the Japanese counterpart of prepositions in English and cannot stand independently, while case particles assign case and can follow postpositions. Her case particles include *ga*, *wo*, *ni*, *no* and *wa*. [7] divides case markers (*ga*, *wo*, *ni* and *wa*) from copula forms (*ni*, *de*, *na* and *no*). He argues that *ni*, *de*, *na* and *no* are the infinitive, gerund and adnominal forms of the copula.

In the class of particles, we include case particles, complementizers, modifying particles and conjunctive particles. We thus assume a common class of the several kinds of particles introduced by the other authors. But they are further divided into subclasses, as can be seen in figure 1. We assume not only a differentiation between case particles and postpositions, but a finer graded distinction that includes different kinds of particles not mentioned by the other authors. *de* is assumed to be a particle and not a copula, as [7] proposes. It belongs to the class of adverbial particles. One major motivation for the type hierarchy is the observation we made of the cooccurrence of particles. Case particles (*ga*, *wo*, *ni*) are those that attach to verbal arguments. A complementizer marks complement sentences. Modifying particles attach to adjuncts. They are further divided into noun-modifying particles and verb-modifying particles. Verb modifying particles can be topic particles, adverbial particles, or postpositions. Some particles can have more than one function, as for example *ni* has the function of a case particle and an adverbial particle. Figure 1 shows the type hierarchy of Japanese particles. The next sections examine the individual types of particles.

2.1 Case Particles

There is no number nor gender agreement between noun phrase and verb. The verbs assign case to the noun phrases. This is marked by the case particles. Therefore these have a syntactic function, but not a semantic one. Unlike in English, the grammatical functions cannot be assigned through positions in the sentence or

c-command-relations, since Japanese exhibits no fixed word position for verbal arguments. The assignment of the grammatical function is not expressed by the case particle alone but only in connection with the verbal valency. There are verbs that require *ga*-marked objects, while in most cases the *ga*-marked argument is the subject:

- (1) nantoka yotei ga toreru N desu ga
 somehow time GA can take COP SAP
 (Somehow (I) can find some time.)

Japanese is described as a head-final language. [1] therefore assumes only one phrase structure rule: **Mother** → **Daughter Head**. However, research literature questions whether this also applies to nominal phrases and their case particles. [9]:45 assume Japanese case particles to be markers.

On the one hand, there are several reasons to distinguish case particles and modifying particles. On the other hand, I doubt whether it is reasonable to assume different *phrase structures* for NP+case particle and NP+modifying particle. The phrase-structural distinction of case particles and postpositions leads to problems, when more than one particle occur. The following example comes from the *Verbmobil* corpus:

- (2) naNji kara ga yoroshii desu ka
 what time from GA good COP QUE
 (At what time would you like to start?)

If one now assumes that the modifying particle *kara* is head of *naNji* as well as of the case particle *ga*, the result for *naNji kara ga* with the head-marker structure described in [9]¹ would be as shown in figure 2. The case particle *ga* would have to allow nouns and modifying particles in SPEC. The latter are however normally adjuncts that modify verbal projections. Therefore the head of *kara* entails the information that it can modify a verb. This information is inherited to the head of the whole phrase by the Head-Feature Principle as is to be seen in the tree above. As a result, this is also admitted as an adjunct to a verb, which leads to wrong analyses for sentences like the following one:

- (3) *naNji kara ga sochira ga jikaN ga toremasu ka
 what time from GA you GA time GA can take QUE

If, on the other hand, case particles and topic markers are heads, one receives a consistent and correct processing of this kind of example too. This is because the head information [MOD none] is given from the particle *ga* to the head of the phrase *naNji kara ga*. Thus this phrase is not admitted as an adjunct.

Instead of assuming different phrase structure rules, a distinction of the kinds of particles can be based on lexical types. HPSG offers the possibility to define a common type and to set up specifications for the different types of particles. We assume Japanese to be head-final in this respect. All kinds of particles are analysed as heads of their phrases. The relation between case particle and nominal phrase is a 'Complement-Head' relation. The complement is obligatory and adjacent². Normally the case particle *ga* marks the subject, the case particle *wo* the direct object and the case particle *ni* the indirect object. There are, however, many exceptions. We therefore use predicate-argument-structures instead of a direct assignment of grammatical

¹The Marking Principle says: *In a headed phrase, the MARKING value is token-identical with that of the MARKER-DAUGHTER if any, and with that of the HEAD-DAUGHTER otherwise*[9].

²Obligatory Japanese arguments are always adjacent, and vice versa.

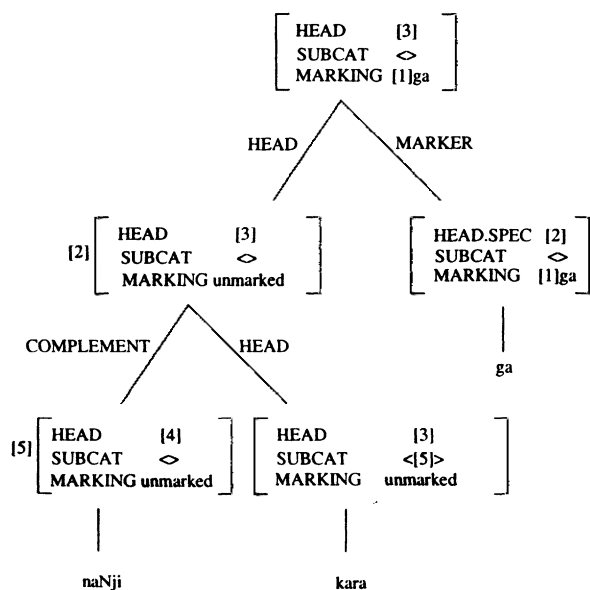


Figure 2: *NaNji kara ga* with Head-Marker Structure

functions by the particles (and possibly transformations). The valency information of the Japanese verbs does not only contain the syntactic category and the semantic restrictions of the subcategorized arguments, but also the case particles they must be annotated with³.

In most cases the *ga*-marked noun phrase is the subject of the sentence. However, this is not always the case. Notably stative verbs subcategorize for *ga*-marked objects. An example is the stative verb *dekimasu*⁴:

- (4) kanojo *ga* oyogi *ga* dekimasu
 she GA swimming GA can
 (She can swim.)

These and other cases are sometimes called 'double-subject constructions' in the literature. But these *ga*-marked noun phrases do not behave like subjects. They are neither subject to restrictions on subject honorification nor subject to reflexive binding by the subject. This can be shown by the following example:

- (5) gogo no hou *ga* yukkuri hanashi *ga* dekimasu ne
 afternoon NO side GA at ease talking GA can SAP
 (We can talk at ease in the afternoon.)

hanashi does not meet the semantic restriction [+animate] stated by the verb *dekimasu* for its subject. There are even *ga*-marked adjuncts. [5] assumes these 'double-subject constructions' to be derived from genitive relations. But this analysis seems not to be true for example 5), because the following sentence is wrong:

- (6) *gogo no hou no yukkuri hanashi *ga* dekimasu ne
 afternoon NO side NO at ease talk GA can SAP

The case particle *wo* normally marks the direct object of the sentence. In contrast to *ga*, no two phrases in one clause may be marked by *wo*. This restriction is called 'double-*wo* constraint' in research literature (see, for example, [12]:249ff.). Object positions with *wo*-marking as well as subject positions with *ga*-marking can be saturated only once. There are neither double subjects nor double objects. This restriction is also valid for indirect objects. Arguments found must be assigned a saturated status in the subcategorization frame, so that they cannot be saturated again (as in English). The verbs subcategorize for at most one subject, object and indirect object. Only one of these arguments may be marked by *wo*, while a subject and an object may both be marked by *ga*. These attributes are determined by the verbal valency. The *wo*-marked argument is not required to be adjacent to the verb. It is possible to reverse NP-*ga* and NP-*wo* as well as to insert adjuncts between the arguments and the verb.

The particle *ni* can have the function of a case particle as well as that of an adjunct particle modifying the predicate. [10] also identify homophonous *ni* that can mark adjuncts or complements. They use the notion of 'affectedness' to distinguish them. This is however not useful in our domain. [8] suggest testing the possibility of passivization. Some verbs subcategorize for a *ni*-marked object, as for example *naru*:

- (7) raigetsu ni naru N desu *ga*
 next month NI become COP SAP
 (It will be next month.)

ni-marked objects cannot occur twice in the same clause, just as *ga*-marked subjects and *wo*-marked objects. The 'double-*wo* constraint' is neither a specific Japanese restriction nor a specific peculiarity of the Japanese direct object. It is based on the wrong assumption that grammatical functions are assigned by case particles. There are a lot of examples with double NP-*ni*, but these are adjuncts.

The lexical entries of case particles get a case entry in the HEAD. Possible values are *ga*, *wo*, *ni* and *to*. They are neither adjuncts nor specifiers and thus get the entries [MOD none] and [SPEC none]. They subcategorize for an adjacent object. This can be a noun, a postposition or an adverbial particle⁵.

2.2 The Complementizer *to*

to marks adjacent complement sentences that are subcategorized for by verbs like *omou*, *iu* or *kaku*.

- (8) sochira ni ukagaitai to omoimasu node
 you NI visit TO think SAP
 (I would like to visit you.)

³[8] investigates the particles *ni*, *ga* and *wo* and also states that grammatical functions must be clearly distinguished from surface cases

⁴see [4] for a semantic classification of verbs that take *ga*-objects

⁵A fundamental difference between Japanese grammar and English grammar is the fact that verbal arguments can be optional. For example, subjects and objects that refer to the speaker are omitted in most cases in spoken language. The verbal arguments can freely scramble. Additionally, there exist adjacent verbal arguments. To account for this, our subcategorization contains the attributes SAT and VAL. In SAT it is noted, whether a verbal argument is already saturated (such that it cannot be saturated again), optional or adjacent. VAL contains the agreement information for the verbal argument. Adjacency must be checked in every rule that combines heads and arguments or adjuncts.

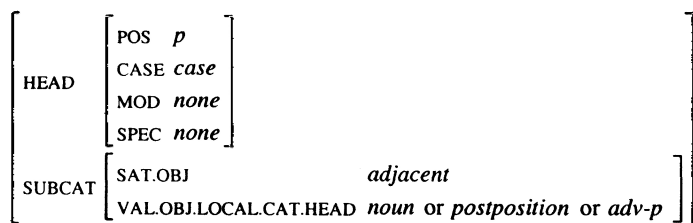


Figure 3: Head and Subcat of Case Particles

Some verbs subcategorize for a *to* marked object. This object can be optional or obligatory with verbs like *kuraberu*.

- (9) kono hi mo chotto hito to au yotei ga
 that day too somewhat people TO meet plan GA
 gozaimasu
 exist
 (That day too, there is a plan to meet some people.)

to in these cases is categorized as a complementizer. Another possibility is that *to* marks an adjunct to a predicate, which qualifies *to* as a verb modifying particle:

- (10) shimizu seNsei to teNjikai wo go-issho sasete itadaku
 Shimizu Prof. TO exhibition together do HON
 (I would like to organize an exhibition with Prof. Shimizu.)

Finally, the complementizer *to* can be an NP conjunction (which will not be considered at the moment, see [4]). The complementizer gets a case entry, because its head is a subtype of *case-particle-head*. It subcategorizes for a noun, a verb, an utterance, an adverbial particle or a postposition.

2.3 Modifying Particles

An essential problem is to find criteria for the distinction of case particles and modifying particles. On the semantic level they can be distinguished in that modifying particles introduce semantics, while case particles have a functional meaning. According to this, the particle *no* is a modifying one, because it introduces attributive meaning, as opposed to ([12]:134), who classifies it as a case particle. Another distinctive criterion that is introduced by [12]:135 says that modifying particles⁶ are obligatory in spoken language, while case particles can be omitted. Case particles are indeed suppressed more often, but there are also cases of suppressed modifying particles. These occur mainly in temporal expressions in our dialogue data:

- (11) soredewa juuyokka no gogo ∅ niiji ∅ robii no
 then 14th NO afternoon ∅ 2 o'clock ∅ lobby NO
 hou de o machi shite orimasu
 side DE HON-wait do AUX-HON
 (I will then wait in the lobby at 2 o'clock on the 14th.)

Finally [12] gives the criterion that case particles can follow modifying particles while modifying particles cannot follow case particles. This criterion in particular implies that a finer distinction is necessary, as we have shown that it is not that easy. This can be realized with HPSG types. According to this criterion, *no* behaves like a modifying particle, while according to the criterion on meaning, it behaves like a case particle. Our first distinction is thus a functional one: modifying particles differ from case particles in that their marked entities are not subcategorized for by the verb. Case particles get the head information [CASE case] that controls agreement between verbs and their arguments. Modifying particles do not get this entry. They get the information in MOD that they can become adjuncts to verbs (verb modifying particles) or nouns (the noun modifying particle *no*) and semantic information. They subcategorize for a noun, as all particles do. The modifying particles share the following features in their lexical entries.

2.3.1 Verb Modifying Particles

The verb modifying particles specify the modification of the verb in MOD. The postpositions modify a (nonauxiliary) verb as an adjunct and subcategorize for a nominal object. [7] treats *ni* and *de* as the infinitive and the gerund form of the copula. *ni* is similar to the infinitive form to the extend that it can take an adverb as its argument (*gogo wa furii ni nat-te i-masu* – afternoon - WA - free - become). But the

⁶He calls them 'postpositions'.

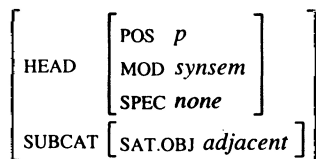


Figure 4: Head and Subcat of Modifying Particles

infinitive is clearly distinct from the characteristics of *ni*, that cannot be used with *N desu*, cannot mark a relative sentence (**John ga furii ni koto*) and cannot be marked with the complementizer *to* (**John ga furii ni to omou*). The adjunctive form 'de' has both qualities of a gerundive copula and qualities of a particle. But there is some data that shows different behaviour of *de* and other gerundives. Firstly, it concerns the cooccurrence possibilities of *de* and other particles, compared to gerundive forms and particles:

de wa - V-te wa de mo - V-te mo de no - V-te no de ni - *V-te ni
 de ga - *V-te ga de wo - *V-te wo de de - *V-te de

Secondly, a gerund may modify auxiliaries, e.g. *shite kudasai*, *shite orimasu*, but *de* may not. Additionally there is something which distinguishes *de* of a copula: it may not subcategorize for a subject. A word that is an adjunct to verbs, subcategorizes for an unmarked noun or a postpositional phrase and is subcategorized for by several particles (see above) fits well into our description of a verb modifying particle. The adverbial particles *ni*, *de* and *to* subcategorize for a noun or a postposition. As already described, *to* behaves like an adverbial particle, too.

2.3.2 The Noun Modifying Particle *NO*

no is a particle that modifies nominal phrases. This is an attributive modification and has a wide range of meanings.⁷ [12]:134ff. assigns *no* to the class of case particles. However, the criteria she sets up to distinguish between case particles and postpositions do not apply to this classification of *no*: firstly, Tsujimura's postpositions have their own semantic meaning. Case particles have a functional meaning. *no* however has a semantic, namely attributive meaning. Secondly, Tsujimura's postpositions are obligatory in spoken language, case particles are optional. *no* is as obligatory as *kara* and *made*. Finally, Case particles can - as Tsujimura states - follow postpositions, but postpositions cannot follow case particles. According to this criterion, *no* behaves like a case particle. *no* combines qualities of case particles with those of modifying particles (which Tsujimura calls 'postpositions'). This means that a special treatment of this particle is necessary. The particle *no* subcategorizes for a noun, as the other particles do. It also modifies a noun. This separates it from the other modifying particles. The particle *no* modifies a noun phrase and occurs after a noun or a verb modifying particle.

2.3.3 Particles of Topicalization

The topic particle *wa* can mark arguments as well as adjuncts. In the case of argument marking it replaces the case particle. In the case of adjunct marking it can replace the verb modifying particle or it can occur after it. On the syntactic level, it has to be decided, whether the topic particle marks an argument or an adjunct, when it occurs without a verb modifying particle. This is difficult because of the optionality of verbal arguments in Japanese. If it marks an argument, it has to be decided which grammatical function this argument has. This problem can often not be solved on the purely syntactic level. Semantic restrictions for verbal arguments are necessary:

(12) basho no hou wa dou shimashou ka
 place NO side WA how shall do QUE
 (How shall we resolve the problem of the place?)

Subject and object of the verb *shimashou* are suppressed in this example. The sentence can be interpreted as having a topic adjunct, but no surface subject and object, when using semantic restrictions for the subject (*agentive*) and the object (*situation*).

[2] analyses Japanese topicalization with a trace that introduces a value in SLASH and the 'Binding Feature Principle' that unifies the value of SLASH with a *wa*-marked element⁸. This treatment is similar to the one introduced by [9] for the treatment of English topicalization. However, Japanese topicalization is fundamentally different from English one. Firstly, it occurs more frequently. Up to 50% of the sentences

⁷See also [11]

⁸The Binding Feature Principle says: *The value of a binding feature of the mother is identical to the union of the values of the binding feature of the daughters minus the category bound in the branching.* [2]

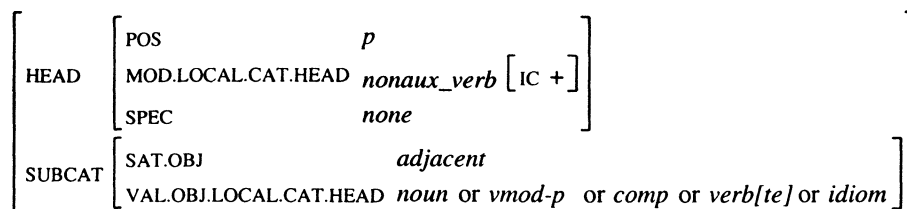


Figure 5: Topic Particle AVM

are concerned ([15]). Secondly, there are examples where the topic occurs in the middle of the sentence, unlike the English topics that occur sentence-initially. Thirdly, suppressing of verbal arguments in Japanese could be called more a rule than an exception in spoken language. The SLASH approach would introduce traces in almost every sentence. This, in connection with scrambling and suppressed particles, could not be restricted in a reasonable way. If one follows Gunji's interpretation of those cases, where the topic-NP can be interpreted as a noun modifying phrase, a genitive gap has to be assumed. But this leads to assuming a genitive gap for every NP that is not modified. Further, genitive modification can be iterated. Finally, two or three occurrences of NP-*wa* are possible in one utterance. Thus, we decided to assign topicalized sentences the same syntactic structure as non-topicalized sentences and to resolve the problem on the lexical level. The topic particle is, on the syntactic level, interpreted as a verbal adjunct. The binding to verbal arguments is left to the semantic interpretation module in VERBMOBIL, see figure 5.

mo is similar to *wa* in some aspects. It can mark a predicative adjunct and can follow *de* and *ni*. But it can also follow *wa*, an adjective and a sentence with question mark:

- (13) dekiru ka mo shiremaseN
 can QUE MO do not know
 (I don't know if I can)

mo is a particle that has the head of a topic-adverbial particle, but a different subcategorization frame than *wa*. *koso* is another topic particle that can occur after nouns, postpositions or adverbial particles.

2.4 Omitted Particles

Some particles can be omitted in Japanese spoken language. Here is an example from the *Verbmobil* corpus:

- (14) rokugatsu ∅ juusaNnichi no kayoubi ∅ gogo kara wa
 June ∅ 13th NO Tuesday ∅ afternoon KARA WA
 ikaga deshou ka
 good COP QUE
 (Would the 13th of June suit you?)

This phenomenon can be found frequently in connection with pronouns and temporal expressions in the domain of appointment scheduling. [3] assumes that exclusively *wa* can be suppressed. [14] however shows that there are contexts, where *ga*, *wo* or even *e* can be omitted. He assigns it as 'phonological deletion'. [5] analyses omitted *wo* particles and explains these with linearization: a particle *wo* can only be omitted, when it occurs directly before a verb. [14] however gives examples to prove the opposite. It can be observed that NPs without particles can fulfill the functions of a verbal argument or of a verbal adjunct (ex. 14). We decided to interpret these NPs as verbal adjuncts and to leave the binding to argument positions to the semantic interpretation. NPs thus get a MOD value that allows them to modify nonauxiliary verbs.

2.5 *ga*-Adjuncts

One can find several examples with *ga* marked adjuncts in the *Verbmobil* data. On the level of information structure it is said that *ga* marks neutral descriptions or exhaustive descriptions (c.f. [1], [4]). Gunji analyses these exhaustive descriptions syntactically in the same way as he analyses his 'type-I topicalization'. They build adjuncts that control gaps or reflexives in the sentence. He views *ga* marked adjuncts without control relations as relying on a very specialized context. However, his treatment leads to problems. Firstly, in all cases, where *ga* marks a constituent that is subcategorized as *ga*-marked by the verb, a second reading is analysed that contains a *ga* marked adjunct controlling a gap. This is not reasonable. The treatment of the different meaning of *ga* marking and *wa* marking belongs to the semantics and not into the phrase structure. Secondly, this treatment assumes gaps. We already criticized this in connection with topicalization. Therefore, we do not need reflexive control at the moment. However, it contains mostly examples with *ga* marked adjuncts without syntactic control relation to the rest of the sentences.

At the level of syntax, we do not decide whether a *ga*-marked subject or object is a neutral description or an exhaustive listing. This decision must be based on context information, where it can be ascertained whether the noun phrase is generic, anaphoric or new. We distinguish occurrences of NP+*ga* that are verbal arguments from those that are adjuncts. The examples for *ga*-marked adjuncts in the *Verbmobil* dialogues either describe a temporal entity or a human. All cases found are predicate modifying. To further restrict exhaustive interpretations, we introduced selectional restrictions for the marked NP, based on observations in the data.

3 Conclusion

The syntactic behaviour of Japanese particles has been analysed based on the *Verbmobil* dialogue data. We observed 25 different particles in 800 dialogues on appointment scheduling. It has been possible to set up a type hierarchy of Japanese particles. We have therefore adopted a lexical treatment instead of a syntactic treatment based on phrase structure. This is based on the different kinds of modification and subcategorization that occur with the particles. We analysed the Japanese particles according to their cooccurrence potential, their modificational behaviour and their occurrence in verbal arguments.

We clarified the question which common characteristics and differences between the individual particles exist. A classification in categories was carried out. After that a model hierarchy could be set up for an HPSG grammar. The simple distinction into case particles and postpositions was proved to be insufficient. The assignment of the grammatical function is done by the verbal valency and not directly by the case particles. The topic particle is ambiguous. Its binding is done by ambiguity and underspecification in the lexicon and not by the Head-Filler Rule as in the HPSG for English ([9]).

The approach presented here is part of the syntactic analysis of Japanese in the *Verbmobil* machine translation system. It is implemented in the PAGE parsing system [13]. It has been proved to be essential for the processing of a large amount of Japanese dialogue data.

Further research concerning coordinating particles (*to*, *ya*, *toka*, *yara*, *ka* etc.) and sentence end particles (*ka*, *node*, *yo*, *ne* etc.) is necessary.

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