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SYNTACTIC CONSTRAINTS ON THE INTERROGATIVE IN JAPANESE

A Model for Predicate Structure in Japanese

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Abstract

This proposal deals with the interrogative sentence in a framework of a model for predicate structure.

Japanese is presumed to lack wh-movement in syntactic sentence structure, yet wh-phrases appear in adequate clausal position in sentences of requests. To deal with this, I shall introduce the concept of focused terms, as they should be defined in the framework of a model of predicate structure accounting. We assume that wh-phrases in Japanese are to be motivated by the focused term and doubt with respect to the speaker's feeling, both of which are abstract syntactic features. These features not only relate closely to modal morphemes that appear in a specific syntactic position in interrogative sentences but also interact with request pragmatic force. Next, we describe the way in which modal morphemes behave in the predicate structure as indicating devices for requests. Thus, a question is formulated in terms of the predicate structure and given a formal definition in a way that reflects syntactic constraints.

We also generalize the analyzing strategy defined for these objects and provide an application to computational linguistics by unification-based and phrase-structure formalism. The remainder of this paper presents an implementation designed to run in terms of a logic grammar formalism, Definite Clause Grammars (DCGs), and experiments are reported.

1 Introduction

Some languages have a system in which interrogative and infinite pronouns are subcategorized into syntactic levels classified by lexicon. But in Japanese, a system in which these are derived from morphemes that stand for dubiety and questionableness is used to indicate requests. To form an interrogative the morpheme and articles are amalgamated, yet the same lexicon is used to indicate an infinite pronoun. The research reported here claims that the syntactic function of the modal morpheme attached to the predicate closely relates to syntactic constraints on the interrogative in defferentiating it from the infinite pronoun. Namely, the role of speech act morphemes as request force indicators is emphasized in analysis of interrogative sentences. In an attempt to understand the syntactic function of the modal morphemes we introduce in this paper a predicate structure to argue for the existence of scope of modal scale in Japanese.

In attempting to interpret an interrogative sentence, the problem of how to determine the unspecified term that is expressed in the interrogative is characterized by the focused term and dubiety with respect to the speaker's feeling, which are of the semantic object in syntax. To achieve this goal, a model for predicate structure is introduced. Thus, we show how the interrogative ranges over a focused term specified within the predicate structure.

2 Linguistic phenomena

Giving a short sketch of the characteristics of Japanese proves the problems with the interrogative to be of importance. The grammatical sentences (1)-(2) below present the structures under discussion. NOM is the abbreviation for nominative; ACC for accusative. The topicalized word is marked TOP.

(1) *dare ga kore wo taberu ka*
(who NOM this ACC eat ?)
'Who eats this?'/'No one eats this.'
dare ga kore wo tabe masu ka
'(May I ask) who eats this?'

(2) *kare ha nani wo suru ka*
(he TOP what ACC do ?)
'What does he do?'/'I have no idea what he does.'/
'Do you know what he does?'
kare ha nani wo shi masu ka
'May I ask what he does?'

Attaching particle '*ka*' to the predicate in the above sentences is the usual way to form the interrogative. The second sentence in each example above contain a modal(politeness) morpheme. The presence of the morpheme is not essential for the sentence to be understood as a question; rather, it inhibits the sentence from being

understood as a request and a rhetorical question. The presence of the polite morpheme in interrogative sentences helps the addressee to understand that an utterance has been made. In this example, dependence on the degree of requestive force leads the notion of politeness marker in interrogative sentences to be reconsidered.

We also argue that a distinctive nature between the interrogative and the infinite pronoun relates to the position of the modal morphemes in the predicate structure. Take for example,

(3)	*dare*	*ga*	*heya*	*ni*	*i*	*masu*	*ka*
	(who	NOM	room	DAT	be		?)
	'Who is in the room?'						
(4)	*dare*	*ka*	*heya*	*ni*	*i*	*masu*	*ka*
	(someone	?	room	LOC	be		?)
	'Is someone in the room?'						

The noun phrase '*dare ga*' ('who' in English) in (3) can be recognized as an interrogative word. The meaning of the sentence is that we are asking about the identity of the person in the room. In (4), we are simply asking whether someone is there. A completely different usage of '*ka*', however, can be seen in the following example:

(5) *dare ka heya ni i masu*
'Someone is in the room.'

(6) **dare ga heya ni i masu*
(an ungrammatical sentence)

As shown in (5), it belongs to the declarative sentence group, though this is an ungrammatical sentence in which '*ka*' is substituted for '*ga*' at the noun phrase '*dare ka*', as in (4).

Given these observations, we can see that there is a very clear distinction between the interrogative (3),(4) and the declarative (5) given above. In (3),(4) the particle '*ka*' is used at the end of sentences, in other words, attached at the end of sentences to express doubt, but in (5), it is not. On account of the above, the approach to the interrogative should be taken to concern the functionality of focusing on the question of how unspecified terms or uncertain objects are contained within the interrogative. We also consider the potential role of the modal morpheme, an appearance of politeness, in indicating requestive force.

2.1 Dealing with interrogative sentences

Generally speaking, the interrogative in Japanese is highly ambiguous. Each interpretation of interrogative sentences in Japanese is traditionally classified as belonging to one of three major categories:

- Request
  - Confirmation Questions
    - Indirect Questions
    - Alternative Questions
  - Information Questions
- Invitations
- Intentions (including rhetorical questions)

In computational linguistics, the interrogative expression in Japanese generates two problems:

1. How to understand a expression as a request
2. How to recognize the unspecified term in the sentence to be expressed

In this paper we address the problems of explaining the functionality of structural differences in distinguishing between sentences and of choosing the unspecified term from states of affairs that are expressed in the interrogative in Japanese. We further attempt to characterize these differing properties in such a way that a complex layer construction can be related to the rules governing sentences in Japanese.

From a computational point of view of language processing, the application of computer-based tools with natural language interfaces, such as a database query system, requires not only understanding a interrogative as a question but also recognizing the unspecified term in the sentence to be expressed. It comes before accurate analysis involving recognition processes at the syntactic level because the competence of most intelligent systems is usually bound to the ability to analyze sentences. For this reason, section 5 presents an implementation designed to run in terms of a logic grammar formalism, Definite Clause Grammars (DCGs), and experiments are reported.

3 The concept of focused term

3.1 The structure of predicative

It is perfectly acceptable for Japanese to read, write, and speak a sentence without a subject. When they want to express a sentence that has a general meaning, they must omit the subject from the sentence. Thus, it is said that in Japanese the existence or nonexistence of the subject has nothing to do with the classification of the sentences [4]. Another notable aspect of Japanese sentences is that there is a very clear distinction between prescriptive sentences and narrative sentences. In the former the particle '*wa*' (topic marker) is used; in the latter it is not. The omission of the topic in prescriptive sentences is grammatical. Difficulty arises from the fact that there is the same form for narrative sentences.

The fact that in a Japanese sentence the predicate, which holds the sentence together, comes at end means that we need to elaborate on the structure of predicative.

Taking these observations into account, the organization of Japanese sentence construction is to be viewed as a single system of predicates. This is taken to be an abstract syntactic organization that must be assigned to a constituent at the sentence level for parsing. The struc-

tural accounts of the predicative already exist in the literature for Japanese [5]. In [5] it is recognized that there are several descriptive strata, each corresponding to an abstract level of syntactic representation, in which the way syntactic form of a sentence contributes to relations between constituents. According to the conception, the structure of a sentence can represent those properties of syntactic form. However, for the lack of an abstract level of semantics, we need to construct the syntactic representation which is semantically interpreted, when faced with the semantic interpretation of sentences.

3.2 Proposed framework

In this section, we suggest an extended framework for the structure of the predictive in Japanese. The main points of this extenstion are as follows: (1) there is a layer located between state of affairs and mood layer; (2) the structure is enable to treat variables used for scoping properties of quantifier and negation, anaphor term to be bound, and such kinds of semantics; (3) morphological word construction and syntactic structural analysis can be unified under the integrated structural approach for Japanese.

Take for example, topic-descriptive construction belonging to a higher layer of the structure. The proposition is in the low layer and a state of affairs is in the middle layer of construction. We can illustrate this with figure 1.

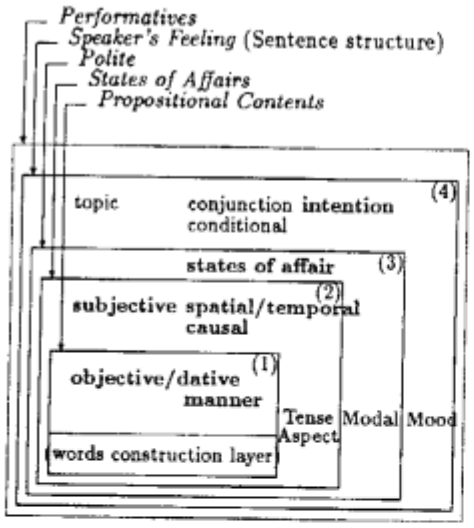

Figure 1: Construction of predicative

Here the states of affairs in the modal layer relating to politeness is the content to be expressed. The mood layer corresponds to the *speaker's feeling* : decision, supposition, determination, command, doubt, uncertainty and so forth. Most of the sentences can be classified and represented under the structure. As section 4 will describe, for every interrogative sentence with a wh-word, the constituent to be focused is forced to be located in latent positions, emphasized by bold type. The interpretation of interrogative sentences is subject to the position of the focused term and feature associated with the mood layer.

4 Focus account for interrogative sentences

According to this form (figure 1), we make the following assumptions on the basis of the proposed constraints:

- Focused position of information questions interpretation may occupy the positions within Modal layer.
- Focused position of confirmation questions interpretation may occupy the position on states of affair corresponding to Modal layer.
- Focused position of invitations interpretation may occupy the position on intention being belong to Mood layer.

Furthermore, we assume that there is a linguistic difference between layers. Modal morphemes '*masu*'/'*nodesu*' contribute to the meaning of the interrogative the they occur. Occurrence of mood morpheme '*ka*' in the mood layer leads a sentence to be interpreted as an interrogative sentence. Focused constituents are influenced by the position in which mood morpheme '*ka*' is located. '*masu*'/'*nodesu*' and '*ka*' are defined as +polite, +doubt. The words traditionally called wh-word have the feature +uncertain. Consider the following data:

(7) *dare* *ka* *tabe* *masu*
(who (+doubt) eat (+polite))
'Someone eats it.'

(8) *dare* *ga* *tabe* *masu* *ka*
(who NOM eat (+polite) (+doubt)
'Who eats it?'

We posit that sentences such as (7) and (8) involve focused constituents, whereby variables that must be bound to certain objects are introduced like A'-position in GB-theory. 'Focused' means an abstract syntactic feature that is generated at predicate structures in some constraints, and once generated must be located in latent positions at predicate structures. Focused assignment creates the following structure.

(9) $[_{level} \cdots _{focused\ on} C_i \ldots]$

where C_i is the focused constituent that is to be assignment to a certain object corresponding to an empty category. In Japanese, focused constituents comprise interrogative pronoun and indefinite pronoun. We can illustrate this with (10) and (11):

(10) [4[3[2 *dare ka* *focused on subjective*[1 *tabe*]]*masu*]]
('someone' : indefinite pronoun)

(11) [4[3[2 *dare ga* *focused on subjective*[1 *tabe*]]*masu*] *ka*]
('who' : interrogative pronoun)

Our assumption of focused term in the structure of predicative has the following advantages.

4.1 Requests and Intentions reading

A focused term may be located either in the mood layer, in the modal layer, or in the event layer. This syntactic difference is crucial if we wish to explain how syntactic dependencies contribute to semantic interpretations: intentions interpretation, requests interpretation, and invitations interpretation. We claim that the various focused term positions give the clue to understanding the different kinds of interpretation.

The relevance of these is illustrated by the following examples:

(12) Intentions interpretation
dare *ga* *taberu* *ka*
(who NOM eats (+doubt))
'Nobody eats it.'
[4 *focused on intention*[3[2 *dare ga* [1 *tabe*]]*ru*] *ka*]

(13) Request (Information Questions) interpretation
dare *ga* *taberu* *ka*
(who NOM eats (+doubt))
'Who eats it?'
[4[3[2 *dare ga* *focused on subjective*[1 *tabe*]]*ru*] *ka*]

The addition of modal morpheme '*masu*' rules out an intentions interpretation of sentences such as (12), leaving only the request reading.

Thus 'masu' used with interrogatives is a clear illocutionary force indicator, while simultaneously it also serves as a marker of politeness. The indicator is viewed as a quantifier that operates on its scope of states of affairs.

Consider the following occurrences of modal morpheme '*masu*'.

(14) *dare* *ga* *iki* *masu* *ka*
(Who NOM go (+polite) (+doubt))
'Who goes there?'
[4[3[2,1 *focused on subjective*]]]
Information questions

(15) *dare* *ka* *iki* *masu* *ka*
(who (+doubt) go (+polite) (+doubt))
'Does anyone go there?'
[4[3 *focused on states of affairs*[2,1]]]
Confirmation Questions

When interrogatives are used, as in (14),(15), the addition of '*masu*' seems to have two functions. One is to reinforce the requestive force of a question. The other is as a politeness marker, meant to soften the imposition involved in giving direct questions. Interrogatory sentences with '*masu*' are assigned by a 'request force only' interpretation.

According to the above analysis, the focused terms we introduce at the predicate structure, and representing the features +uncertain, +polite, and +doubt as semantic features with morphemes are taken into account for syntactic constraints imposed on interrogative sentences.

4.2 Information questions and confirmation questions reading

Another advantage is that the distinction between confirmation and information questions is generalized by focused positions at the predicate structure. As is the case for example (16), we get here two readings, one of which is focused on the manner of going, as in (17). The other interpretation, such as that in (18), is focused on the state of affairs, where the speaker wants to know whether you went or not, regardless of how.

(16) *aruite* *iki* *masu* *ka*
(by walking go (+polite) (+doubt))
'Do you walk there?'

(17) [4[3[2,1 *focused on manner*]]]

(18) [4[3 *focused on states of affairs*[2,1]]]

4.3 More than one focused term is grammatical

By our analysis, the number of possibilities focused on is not limited. As example (19) shows, this is understood to have two focusing points. We call such a question a complex type.

(19) *dare* *ga* *nani* *wo* *tabe* *masu* *ka*
(who NOM what ACC eat (+polite) (+doubt))
'Who eats what?'
'Who eats and what do they eat?'

(20) [4[3[2 *focused on subjective*[1 *focused on objective*]]]]

5 An Implementation

In the preceding section, we have focused on structural representation of predicates as to how constraints on the interrogative in Japanese were formalized. The framework proposed here assumes that the grammar is unification-based or logic-based and has phrase-structure formalism. We will describe the formalism in terms of an implementation of it for definite-clause grammars (DCG).

5.1 A Prolog Implementation

In the implementation, a term of the form node 'Cat_N(SYN,X,REL,F,PRO)' represents a phrase with the syntactic and semantic information.

```
Cat_N(SYN,X,REL,F,PRO) -->
 Cat_N1(SYN1,X1,REL1,F1,PRO1),
   Cat_N2(SYN2,X2,REL2,F2,PRO2).
```

The first argument to Cat_N is the syntactic information, which prevents the generation search space from having infinite branches. The second argument is the indicator standing for the head of the phrase. The third argument is semantic information that guards against producing a nonsensical sentence. Thus sentences parsed and generated are guaranteed to be both syntactically and semantically correct. F placed last but one is a predicate frame corresponding to a word (typically : a verb). The last argument is represented as the difference list [(que,FOQ,SOQ) | X]-X, that is the list containing a que-feature, ana-feature and so forth to be traversing in the course of both analysis and generation. The entry '*dare*'('who' in English) is as follows:

```
n_0([cat(n),morph(dare)],FOQ,□,(□,□),
          ([(que,FOQ,SOQ)|X],[X|Y])) -->
           [dare]. % Who
```

SYN and REL are formally modeled by feature structures, represented as a horn clause whose head is labeled by names of linguistic features and whose argument may be labeled by atoms interpreted as feature values. Thus, feature structures are notated by an attribute-value list such as shown in the above rule.

5.2 Focus of Question Storage

We will outline here how to find out the focused term of a question from a sentence with an interrogative. For this, we will associate a focus store with certain words and categories and add to the grammar suitable store-manipulation rules. Each category whose constituents may create store elements will have a store feature. For a category whose semantics can be the focused term of a question, it applies the scope to the semantics of the category, as shown in the rule below.

```
n_0(SYN,FOQ,REL,F,([(que,FOQ,SOQ)|X],[X|Y])) -->
        ['Q-word'].
```

The feature (que,FOQ,SOQ) represents an unspecified term focused on by a question with a question word, bound variable FOQ and scope SOQ. In addition, a rule is necessary to join the focused term of the immediate constituents with a scope that appears in the layer.

```
v_4(SYN,X,REL,F,([(que,FOQ,X)|Y],Y)) -->
      v_3(SYN,X,REL,F,([(que,FOQ,X)|Y],Y)).
```

The above states that the scope of a question is the variable X bound by a layer with the (que,FOQ,SOQ) feature, meaning that the variable X to which the main verb is being assigned represents the state of affairs in the sentence. The constraint on the scope not being out of the state of affairs layer can be done by distinguishing it from the contents to be expressed in the sentence. In practice, this can be achieved by treating categories as constraints at the layer level.

Finally, we introduce the verbal phrases that create scope to be joined with foci. They are of the form:

```
v_0(SYN,X,[eat(X,[A,O])],(□,[(ga,subj,A),
      (wo,comp,O)]),(□,□)) -->
          [tabe]. % Eat
```

where X is the variable bound by the scope of the question arising from the verbal phrase. The rules corresponding to the focused term of the question and the focus' scope are outlined here.

5.3 An example

In this section we will briefly illustrate the characteristics of the parsing process by means of the analysis of a simple sentence. Let us consider, as an example, the following question:

(21) *dare ga tabe masu ka*
'Who is eating?'

Grammar fragment in figure 3 are used in parsing. Subcategorization for complements is performed lexically as shown in (41).

```
sentence((SYN,X,REL,F,P,□))-->
   v_5(SYN,X,REL,F,(P,□)). (26)
v_5(SYN,X,[type(X,decision),mood(X,Mood)|REL],F,PRO)-->
   v_4(SYN,X,[mood(X,Mood)|REL],F,PRO). (27)
v_5(SYN,X,[type(X,doubt),mood(X,Mood),deny(X,Deny),
     polite(X,yes)|REL],F,PRO)-->
   v_5(SYN,X,[type(X,decison),mood(X,Mood),deny(X,Deny),
     polite(X,yes)|REL],F,PRO),[ka]. (28)
...
v_4([ch(u_w)|SYN],X,[mood(X,unconfirm),deny(X,no),
     aspect(X,progress)|REL],F,PRO)-->
   v_4([ch(u_w)|SYN],X,[aspect(X,progress)|REL],F,PRO),[ru]. (2
v_4([ch(u_w)|SYN],X,[mood(X,unconfirm),deny(X,no),
     aspect(X,state),C|REL],F,PRO)-->
   v_4([ch(u_w)|SYN],X,[C|REL],F,PRO),[ru],
     {not(functor(C,aspect,2))}. (30)
...
v_5([ch(masu)|SYN],X,[type(X,decision),mood(X,unconfirm),
     deny(X,no)|REL],F,PRO)-->
   v_4([ch(masu)|SYN],X,REL,F,PRO),[su]. (31)
...
v_4([ch(masu)|SYN],X,[deny(X,yes),
     aspect(X,progress)|REL],F,PRO)-->
   vinf_3(SYN,X,[aspect(X,progress)|REL],F,PRO),[ma]. (32)
v_4([ch(masu)|SYN],X,[deny(X,yes),
     aspect(X,state),C|REL],F,PRO)-->
   vinf_3(SYN,X,[C|REL],F,PRO),[ma],
     {not(functor(C,aspect,2))}. (33)
...
v_4(SYN,X,REL,F,([(que,FOQ,X)|Y],Y)) -->
   v_3(SYN,X,REL,F,([(que,FOQ,X)|Y],Y)). (34)
...
v_3([Channel|VSYN],VX,[{[syn((Case,nom))|AdvSYN],
  AdvREL,AdvF}|VREL],([(Case,subj,AdvX)|VAL],RL),(P,PT))-->
   adv_3([syn((Case,nom))|AdvSYN],AdvX,AdvREL,AdvF,(P,VP)),
   v_3([Channel|VSYN],VX,VREL,(VAL,VRL),(VP,PT)),
   {assignment(VRL,(Case,subj,AdvX),RL)}. (35)
...
vinf_3([ch(masu),ch(u_w)|SYN],X,REL,F,
              ([(que,FOQ,X)|Y],Y)) -->
   v_3([ch(u_w)|SYN],X,REL,F,([(que,FOQ,X)|Y],Y)). (36)
...
adv_3([syn((ga,nom))|SYN],X,REL,F,PRO)-->
   n_2(SYN,X,REL,F,PRO),case(ga). (37)
```

```
...
v_3(SYN,X,REL,F,PRO) -->
   v_0(SYN,X,REL,F,PRO). (38)
...
n_2(SYN,X,REL,F,PRO) -->
   n_0(SYN,X,REL,F,PRO). (39)
...
n_2([mark(Case)|SYN],X,REL,F,PRO) -->
   n_0(SYN,X,REL,F,PRO),postp(Case). (40)
...
% ENTRIES
v_0([ch(u_w),cat(v),morph(tabe)],E,[E,eat(E,[A,0])],
   ([],[(ga,subj,A),(wo,comp,0)]),PRO) -->
     [tabe]. % Eat (41)
...
n_0([cat(n),morph(dare)],FOQ,[FOQ],([].[]),
   ([(que,FOQ,SOQ)|X],X)) -->
     [dare]. % Who (42)
...
case(ga) -->
     [ga]. % post positional word(subjective) (43)
case(wo) -->
     [wo]. % post positional word(objective) (44)
```

Figure 3: Grammar Fragment

Figure 4 shows the analysis tree of the experiment running grammar with the question. The rule numbers are keyed to the grammar.

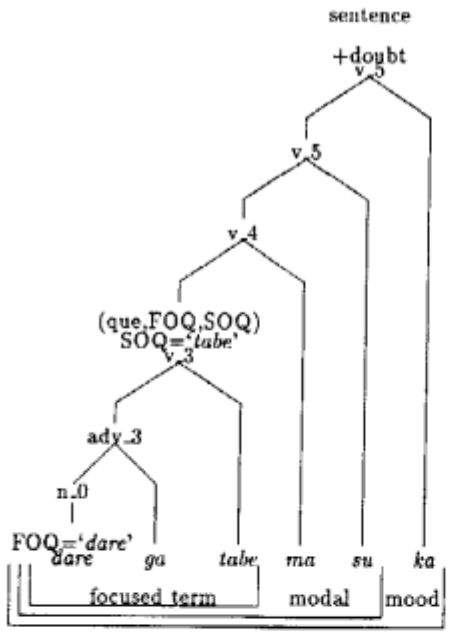

Figure 4 : Analysis Tree and Que-feature Traversal

We have developed more-extensive experimental grammars by using a complex-layer construction form.

6 Conclusion

The paper has presented an approach to the analysis of questions in Japanese. We have argued that they are subject to two syntactic constraints: focused term and its position, which indicate unspecified states of affairs to be expressed; and a constraint on a main predicate requiring that it is under obligation to describe modal expression if the sentence contains the content of unspecified states of affairs. A proposal for a predicate structure has been made for the purpose of treating previous analysis. This framework, being preferable to logic-based grammar, has been implemented in DCG. Experiments with a subset of interrogatives have been performed on PSI-II (Personal Sequential Inference Machine). We are now studying another problem of interrogative based on the complex-layer structure framework.

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