

# SEMANTIC INTERPRETATION OF A JAPANESE COMPLEX SENTENCE IN AN ADVISORY DIALOGUE

— Focused on the Postpositional Word “KEDO,”  
Which Works as a Conjunction Between Clauses —

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## ABSTRACT

We are developing a spoken dialogue system that helps a computer user perform his tasks through question-answering. In this paper, we propose a method for semantic interpretation of a complex sentence connected by a conjunction, “KEDO.” “KEDO” is a postpositional word, and forms an adverbial clause. First, complex sentences containing “KEDO” are extracted from an advisory dialogue database and the semantic role of “KEDO” in each sentence is analyzed. Next, each sentence is decomposed into the part before “KEDO” and the part after “KEDO,” and each part is expressed in a semantic structure we developed. Finally, the relationship between the semantic structures and the semantic roles is formalized into rules for semantic interpretation. Our method interprets a complex sentence semantically by applying the rules to the two semantic structures generated from the sentence. As a result, the semantic structures are modified or transformed into another if necessary.

## 1. INTRODUCTION

We are developing a spoken dialogue system that helps a computer user perform his tasks on a computer through question-answering [1]. We have already proposed a method for semantic interpretation [2][3] that constructs a semantic structure from a spoken sentence.

The semantic structure we developed is called a Communicative Intention (CI) description. A CI description consists of a CI type and an utterance proposition. A CI type represents the kind of request a speaker is making, and an utterance proposition represents actions, states, objects, and relations that can be defined in a task domain. A complex sentence corresponding to two or more CI types cannot be expressed in a single CI description, because a CI type is a symbol and has no structure.

Hence, the postpositional word “KEDO,” which works as a conjunction between two clauses, and forms a complex sentence corresponding to two CI types, is the focus of this paper. According to a Japanese-English dictionary, “KEDO” is usually translated as “but” or “although.” In spoken Japanese, however, “KEDO” is often used in a broader sense, and for its broadness the word often appears in advisory dialogues.

In this paper, we propose a method for semantic interpretation of a complex sentence whose clauses are connected by

“KEDO.” As a first step in developing the method, complex sentences containing “KEDO” are extracted from an advisory dialogue database [4]. Next, the semantic role of “KEDO” in each sentence is analyzed such that the sentences are classified into five clusters. Then the following operation is done for the complex sentences classified into each cluster. First, each sentence is decomposed into the part before “KEDO” and the part after “KEDO.” Then each part is expressed by a CI description. Finally, the relationship between the two CI descriptions and the semantic role of “KEDO” in the cluster is formalized as a semantic interpretation rule.

We know that “KEDO,” “KEREDO,” and “KEDOMO” are reduction forms of the postpositional word “KEREDOMO,” but for the purpose of this study, they are all denoted “KEDO” without distinguishing between them. We assume e-mail handling program XMH [6] as the task domain in which our spoken dialogue system works. XMH runs in the X-window environment on a UNIX computer, and has functions to send, receive, compose, and store a message. The spoken sentences to be analyzed here are all concerned with the use of XMH.

## 2. COLLECTION OF COMPLEX SENTENCES CONTAINING “KEDO”

Dialogue experiments were made in which a human consultant, rather than our spoken dialogue system under construction, helped 42 naive computer users use XMH through question-answering, and users’ spontaneous speech was recorded on tapes. Then the users’ speech was transcribed, and an advisory dialogue database was constructed as a text database containing 855 spoken sentences [4].

All of the complex sentences containing “KEDO” in the database were extracted, and a corpus was constructed from them. The corpus had 54 complex sentences, which correspond to 55 cases of “KEDO,” where a “KEDO” case is defined as a triplet of the part before “KEDO,” “KEDO” itself, and the part after “KEDO.”

Linguistic phenomena such as interjections, repairs, and hesitations were removed when constructing the corpus, but omission and wrong use of postpositional words, and inversion were retained. Automatic extraction and modification of such linguistic phenomena is one of our future objectives.

### 3. DEFINITION OF COMMUNICATIVE INTENTION

The meaning of a user’s request is represented in a CI description with the following form [2][3]:

((CI type) (utterance proposition)).

A CI type represents the kind of request, and is selected from the 12 different symbols shown in Tables 1 and 2. Questions corresponding to subtypes “OK” and “NO” in Table 2 often include the expressions of “shitara iidesuka (Should I)” and “shitewa ikenaiidesuka (Must I),” respectively. The subtype “NIL” is often omitted. An utterance proposition represents actions, states, objects, and relations that can be defined in the XMH task domain, and is described in frame representation. Here, the CI description representing the spoken sentence “henjiwo yomuniwa doushitara iidesuka (What should I do to read a reply?)” is shown as an example in Figure 1. In Figure 1, we say that the Japanese sentence, which was written in romaji, consists of three clauses; two adverbial clauses “henjiwo yomuniwa (to read a reply)” and “doushitara (What do I do),” and a main clause “iidesuka (should I).” Nevertheless, just one CI description is constructed from the three clauses. This is because the kind of request that the sentence represents is represented by the CI type “ask-how.”

### 4. DESIGN OF SEMANTIC INTERPRETATION RULES

In this section, the 55 “KEDO” cases obtained in 2 are analyzed, and a method for semantic interpretation is proposed for a complex sentence connected by “KEDO.” First, the 55 “KEDO” cases are classified into several clusters from the standpoint of the semantic role of “KEDO.” That is, cases in which the semantic relation between the part before “KEDO” and the part after “KEDO” are the same are collected in one cluster. As the result of this classification, five clusters were created.

In the following, the semantic role of “KEDO” in each cluster is shown, and is formalized as a semantic interpretation rule with the “if-then” format. The number of “KEDO” cases in each cluster is shown with the name of the cluster.

#### Cluster I (Explanation A) . . . 11 cases

In the “KEDO” cases in this cluster, the part before “KEDO” represents an event that has just happened, and the part after “KEDO” corresponds to a question on procedure and contains no information as to which procedure a user is asking for. For example, in the “KEDO” case consisting of “messējiga kietyattandesu (a message has disappeared),” “KEDO,” and “doushitara iidesyouka (what should I do),” the part before “KEDO” represents the target event (the disappearance of a message), and the part after “KEDO” represents a user asking what to do. Consequently, a semantic interpretation rule can be defined as follows.

CI Types	Meanings of utterances
ask-how	wh-questions on procedures
ask-about	wh-questions on concepts
ask-wh	wh-questions on attribute values
ask-if	yes/no-questions on truth values
have-belief	expressions of beliefs
have-goal	expressions of task goals
d-start	clue words when one starts a dialogue
d-end	clue words when one ends a dialogue

**Table 1:** User’s spoken sentences are classified into eight CI types from the standpoint of what the users required of the consultant.

Question contents	ask-if	ask-wh
Permission of future event (by positive expressions)	OK	OK
(by negative expressions)	NO	–
Event in XMH	NIL (omissible)	NIL (omissible)
Other	EQ	–

**Table 2:** The CI types “ask-if” and “ask-wh” are subcategorized. The spoken sentences are classified into four subtypes: (a) “OK” – questions in which permission for an event is applied for by asking about the acceptability of its happening, (b) “NO” – questions in which permission for an event is applied for in the form of prohibition, (c) “NIL” – questions concerning either actions that were performed in XMH or states that exist or existed in XMH, and (d) “EQ” – questions concerning the task domain knowledge.

- **If** the CI type of the part before “KEDO” is have-belief, and the CI type of the other part is ask-how, and no utterance proposition is constructed from the part after “KEDO,”
- **then** an action frame is generated as an utterance proposition. The action frame represents operations for changing the current state into the state that existed just before the onset of the event represented in the part before “KEDO.”

For example, for the “KEDO” case shown above, an action frame is generated to change the current state into the state that existed just before the message disappeared. It is dealt with as an utterance proposition for the part after “KEDO.” If such an action frame cannot be generated, the user is informed of the fact, and the CI description for the part after “KEDO” is discarded.

The above described the semantic interpretation rule for Cluster I. There is a special case in which an utterance proposition for the part after “KEDO” can be generated more easily for a subset of the “KEDO” cases in Cluster I. This special case is described below.

(ask-how #⟨DisplayMessage #X129CA23⟩)

(a) This CI description represents the spoken sentence “henjiwo yomuniwa doushitara iindesuka (What should I do to read a reply?).”

Frame Class	DisplayMessage
ID No.	#X129CA23
Target Slot	#⟨RepliedMessage #X138DB77⟩
⋮	⋮

(b) This shows the internal structure of the action frame representing “henjiwo yomu (reading a reply).”

**Figure 1:** Example of a CI description and internal structure of the utterance proposition (action frame) in the CI description.

#### Subcluster (Explanation A2) ··· 5 of 11 cases

In the “KEDO” cases in this subcluster, the part before “KEDO” corresponds to a negative sentence, and represents the negation of an action or a state. For example, in the “KEDO” case consisting of “messējiga detekonaindesu (a message does not appear),” “KEDO,” and “doushitara iindesuka (what should I do),” the action that a message appears is negated in the part before “KEDO.” Consequently, we can define a semantic interpretation rule as follows.

- **If** a complex sentence satisfies the condition for Cluster I, and an utterance proposition represents the negation of a proposition,
- **then** the proposition is dealt with as an utterance proposition for the part after “KEDO.”

#### Cluster II (Explanation B) ··· 3 cases

For example, the “KEDO” case consisting of “inbokusuni torikondeshimattandesu (I just incorporated it in the inbox folder),” “KEDO,” and “yokattadesuka (Is it OK)” is classified into this cluster. That is, a “KEDO” case belonging to this cluster has the feature that an event that has just happened is presented in the part before “KEDO,” and a question from which no utterance proposition is constructed is asked in the part after “KEDO.” Although this feature is almost the same as the feature of Cluster I, the difference from the cases in Cluster I is that the CI type of the part after “KEDO” is not ask-how but ask-if:EQ. When the CI type is ask-if:EQ, the corresponding utterance proposition must be a state frame as described in **3**. Hence, the following semantic interpretation rule can be defined.

- **If** CI types of the part before “KEDO” and the part after “KEDO” are have-belief and ask-if:EQ, respectively, and no utterance proposition is constructed from the part after “KEDO,”

- **then**, if an utterance proposition constructed from the part before “KEDO” is a state frame, the state frame is processed as an utterance proposition for the part after “KEDO.” If it is an action frame, the state just after the act represented by the action frame occurred is represented as a state frame, and the state frame becomes an utterance proposition for the part after “KEDO.”

#### Cluster III (Emphasis) ··· 16 cases

One of the “KEDO” cases in this cluster consists of “messējino yomikataga wakaranaidesu (I don’t know how to read a message),” “KEDO,” and “doushitara iindesuka (what should I do).” As this example shows, the main meaning of the “KEDO” case is represented in the part before “KEDO,” and the part after “KEDO” merely emphasizes the meaning. Consequently, the following semantic interpretation rule can be defined.

- **If** the CI type of the part before “KEDO” is not have-belief, the CI type of the part after “KEDO” is ask-how, and no utterance proposition is constructed from the part after “KEDO,”
- **then** the CI description for the part after “KEDO” is discarded.

#### Cluster IV (Paraphrase) ··· 4 cases

This cluster has a “KEDO” case consisting of “tuginogyouwo nyuuryokusitaindesu (I want to input the next line),” “KEDO,” and “doushitara tuginogyouni ikundesuka (how can I input the next line)” as an element. That is, CI types of the part before “KEDO” and the part after “KEDO” are have-goal and ask-how, respectively. Here, we analyzed the semantic relation between the part before “KEDO” and the part after “KEDO” in each case in this cluster. We found that the part after “KEDO” can be regarded as a paraphrase of the part before “KEDO.” Consequently, the following can be defined as a semantic interpretation rule for Cluster IV.

- **If** CI types of the part before “KEDO” and the part after “KEDO” are have-goal and ask-how, respectively, and an utterance proposition can be constructed from the part after “KEDO,”
- **then** ⟨utterance proposition⟩ is regarded as one for the part before “KEDO,” and the utterance proposition constructed from the part after “KEDO” is discarded.

The ⟨utterance proposition⟩ is generated in the following way. If the two utterance propositions constructed from both parts are unifiable, they are unified. Then the result of unification is dealt with as the ⟨utterance proposition⟩. If the two are not unifiable, we consider that some misunderstanding is involved in the complex sentence. Accordingly, the existence and contents of the misunderstanding are presented to the user. Then the utterance proposition for the part before “KEDO” is dealt with as the ⟨utterance proposition⟩.

In the “KEDO” cases we collected, only the combination of have-goal and ask-how was observed. Other combinations should be taken into consideration. The condition of the above rule can be extended as follows.

- If CI types of the part before “KEDO” and the part after “KEDO” are have-goal or ask-how, and an utterance proposition can be constructed from the part after “KEDO,”

#### Cluster V (Independent) . . . 21 cases

We analyzed the “KEDO” cases in this cluster. For example, one of them consists of “roinomessējiwa dekimashita (I finished composing a message to Roy),” “KEDO,” and “honzonshite okuttara iindesuka (should I save and send it).” As the result of analysis, we find that user’s belief or task goal is presented in the part before “KEDO,” and the part after “KEDO” is made under the belief or task goal. Such a relation between the parts should hold even if the parts are expressed independently as two sentences. Consequently, the following semantic interpretation rule can be defined.

- If the CI type of the part before “KEDO” is have-belief or have-goal, no utterance proposition is constructed from the part after “KEDO,” and the condition for Cluster IV is not satisfied,
- then the CI descriptions constructed from the part before “KEDO” and the part after “KEDO” are processed independently of each other.

As mentioned above, the semantic role of “KEDO” in this cluster has only a slight effect on other components in the complex sentence. However, we find that candidates for anaphora resolution and ellipsis supplement for the part after “KEDO” are often observed in the part before “KEDO.” For example, in the above “KEDO” case, the “a message to Roy” in the part before “KEDO” should be bound in the target slots of “save” and “send” in the part after “KEDO.” Consequently, we assert that information for anaphora resolution and ellipsis supplement can be obtained from the part before “KEDO.”

In this section, the semantic role of “KEDO” in each cluster was clarified, and a semantic interpretation rule was designed for each semantic role.

## 5. AN EXAMPLE OF SEMANTIC INTERPRETATION

The meaning of a complex sentence containing “KEDO” is interpreted in the following way.

First, an input complex sentence is morphologically analyzed by JUMAN [7]. Next, information for constructing an utterance proposition and that for determining a CI type are extracted from the output of JUMAN, which is a sequence of tagged morphemes [2][3]. If “KEDO” is involved in the extracted information, the information is divided into the sub-information before the “KEDO” and the sub-information after the “KEDO” and a CI description is constructed from each item of sub-information. Finally, the semantic interpretation rules shown in 4 are applied for the two CI descriptions, and a result of semantic interpretation is obtained based on the CI types of the two CI descriptions and whether an utterance proposition can be constructed from the part after “KEDO.”

## 6. CONCLUSION

In this paper, complex sentences containing “KEDO,” which were collected from actual advisory dialogues, were analyzed, and the semantic roles of “KEDO” were clarified. Based on this analysis, the semantic roles were formalized as “if-then” rules.

According to a Japanese grammar reference text, “KEDO” is a postpositional word that forms an adverbial clause corresponding to a clause beginning with “although” or “but.” But, in an actual dialogue, “KEDO” is often used in a broader sense. Such words can often be noted in spoken Japanese. This means that a grammar and a lexicon for spoken language cannot automatically and easily be made from grammars and lexicons used for written language. We consider that a grammar and a lexicon for spoken language should be constructed from spoken dialogue corpora. This is one of our future objectives.

## 7. REFERENCES

- [1] Kumamoto, T., Ito, A. and Ebina, T.: “Design and development of a dialogue-based consultant system for supporting the use of electronic mail,” *Journal of the Communications Research Lab.*, 42, 2, pp. 161-171 (1995).
- [2] Kumamoto, T., Ito, A., and Ebina, T.: “Recognizing user communicative intention in a dialogue-based consultant system,” *Systems and Computers in Japan*, 25, 14, pp. 91-105 (1994).
- [3] Kumamoto, T., Ito, A., and Ebina, T.: “An analysis of Japanese sentences in spoken dialogue and its application to communicative intention recognition,” *Proc. ICSLP '94*, 2, S17-19.1, pp. 943-946, Yokohama, Japan (1994).
- [4] Kumamoto, T., Ito, A. and Ebina, T.: “Design and construction of an advisory dialogue database,” *IEICE Trans. Inf. & Syst.*, E78-D, 4, pp. 420-427 (1995).
- [5] Masuoka, T., and Takubo, Y.: “Kiso nihongo bunpou (basic Japanese grammar),” Kurosio Publishers, Tokyo (1991) (in Japanese).
- [6] Peek, J.: “Mh and xmh – E-mail for users and programmers –,” O’Reilly & Associates, Inc. (1991).
- [7] Myoki, Y., Matsumoto, Y., and Nagao, M.: “User customizable Japanese dictionary system and morphological analyzer,” *Proc. the 42nd Annual Meetings of IPSJ*, 1C-9, pp. 3-17 - 3-18 (1991) (in Japanese).