--- AN APPROACH TO A SEMANTIC ANALYSIS OF METAPHOR ---

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Abstract

The present study deals with conflict resolution process in metaphorical interpretation for the noun phrase. In order to make the problem more explicit, we have reviewed the knowledge representation with conflict both from cognitive psychology and artificial intelligence. Then, we propose a semantic model which is obtained from the notion of Linguistics as Chemistry. That is, the model called "Semistry" is introduced so as to interprete a metaphor semantic bonds between nouns. By using production system couped with contex free parser (ELINGOL), the working system called META-SIM is constructed to analyze the noun phrase metaphor. Finally, there are discussions on a role of metaphor in human cognitive processing.

1. Introduction

A conflict resolution in semantic analysis is regarded as an important problem in natural language processing. In case of a human cognitive system, this kind of problem was discussed in the realm of behavioral decision making theories, such as Festinger's (1957) theory of cognitive dissonance and Abelson's (1968) Psychological implication. And also, it was discussed in the field of cognitive psychology which dealt with the human information processing mechanism, especially long-term memory (LTM) representation.

The work of Kintsch (1969) in his structure of semantic memory was useful for insight into the conflict resolution in lexical item stored in LTM. He particularly made his attention on the problems on how one semantically unacceptable a sentence.

If one selects the problem from artificial intelligence field, McDermott's (1974) TOPLE in "Ring formalism" was suggestive to a design of inference mechanism which could interprete unacceptable knowledge in a simple world model.

This formarism also guided us about a construction of lexical data in natural language processing.

By following these current issures on knowledge representation, the present study focuses the problem of conflict resolution in semantic analysis of Metaphor both from viewpoints of cognitive psychology and artificial intelligence. For this purposes, we propose a new semantic model which can deal with the metaphorical interpretation together with the inference mechanism. And then, we will demonstrate examples of metaphorical analysis which is based on the proposed semantic model.

2. Semantic representation with conflict knowledge

Metaphor plays an important role in our understanding of language and of the world we describe through language. Thus, there have been a number of researches on the nature of metaphor since the time of Aristotle.

Recently, historical survey on metaphor was made by Ortony, Reynolds & Alter (1978) on their paper titled "Metaphor: Theoretical and Empirical Research". Their main concerns on metaphor are to develop a model of metaphoric comprehension both from Psychological reaction time study and "Schema" based theoretical framework. To quote their paper:

"The structure of a shema is of a series of variables together with relationships among them. There are constraints on the values that the variables may take, but these constraints are rarely absolute, although some values are typical than others. This kind of representation system appears to offer greater flexibility for matching incoming information to previously stored knowledge, and with this flexibility comes a better prospect for dealing with nonliteral use of language. The metaphorical interpretation would be achieved by finding that schema or those schemata that matched the input in such a way as to minimize the required changes in variable range. "

Certainly, the idea of schema described above is one of convergences on the knowledge representations proposed by Rumelhart & Ortony (1977) and Bobrow & Norman (1975). Here, the procedure for the metaphorical interpretation is a kind of pattern-matching process which is based on a semantically acceptable interpretation. In order to make a discussion more explicit, let us consider the same type of problem which deals with knowledge aquisition through the conflict or contradict resolution.

For this purpose, we focus our attention to the semantic structure which is stored in an understanding system.

In case of Kintsch model, this problem is to define a lexical entry used in the semantic memory. And further, the notion of acceptability of sentence is defined by the use of production rules which are applied to the set of propositions stored in memory system. If there exists a production rule for a set of

proposition, the sentence is semantically acceptable. And if not, the sentence is semantically unacceptable. Therefore, if two sentences are contradictory, the memory system must decide which one to keep and which one to disregard by choosing the one with acceptability. In case of McDermot's TOPLE, this kind of contradiction is resolve through the notion of "ring" which can absorb the confliction. This process is accomplished through a procedure called DOUBT. By this procedure, the system can find the allowable course of action to take to patch up a ring.
In this connection, Tanaka (1980) in his SRL, this procedure is carried out through the use of production rule called "without description". In SRL representation which is an extension of Bobrow & Winograd's KRL, knowledge is organized around conceptual entities with associated descriptions and procedures. Therefore, by embedding various procedures to knowledge, lexical item is represented by knowledge unit with associated descriptions and procedures. One type of conceptual entities is the use of hiearchcal relation which was actively utilized by the work of Carbonell's SCHOLAR (1970). In SRL, hiearchical concept is accomplished through part-whole and class-inclusion relations. And further, the conflict resolution was made by the use of the without description. In contrast to TOPLE, a bird like Pengin is represented by the following way.

```
(PENGIN
 unit
 (self (a TORI without
       (hasp = TOBU )))
 (part-of nil)
            .
            .
     other descriptions )
```

Fig.1 SRL's description for pengin

Although we made a quick overview of the related topic on the knowledge with conflict resolution, it is necessary to consider a semantic model which can accept semantically conflict knowledge. That is, any lexical item stored in the understanding system should process a change of meaning through the metaphorical use.

In this section, we will propose a new semantic model in which semantic elements are compared to chemical elements. Here, chemical elements are refered to the dynamic aspect of meaning. In a sense, the theory can be considered as an extension of Arnold Zwicky's 1973 paper, "Linguistics as Chemistry", in Anderson & Kiparsky (Eds.), A Festschrift for Morris Halle. In this connection, some preliminary work on "Linguistic Chemistry" was carried out by Harada & Mizoguchi (1977) in which semantics and lexical elements were also compared to chemical elements (such as molecules, atoms, protons, neutrons and elecrtons). A large part of syntax is now compared to a theory of semantic "bondage". The semantic equivalent of 'chemical reaction' is a theory of semantic amalgamation. The analogy with chemistry may not be completely felicitous, but at the present moment it is a least useful in shaping a new theory of semantics.

The first step for constructing a chemically interpreted model of semantics, or "Semistry", so to speak, is to study the bondage among atoms and molecules. For this, it is necessary to develop a theory of valence. Valence is defined as the capacity of an atom to enter into chemical (or semantic) combination with other atoms. It is possible to assign a value to the valence displayed by an atom in particular compound. This notion must be the reader who is well-informed of the European tradition of "Valenzgrammatik". Here, however, we will develop a theory of valence totally independently of European tradition.

Before going into a detail of Semistry, let us show you a concrete exsample which is selected from Schank (1973) of his Concepual Dependency theory (CDT for short). Here, "Semantic primitives of CDT" are compared to chemical elements. In the chemical elements, there are three types of chemical bondages; 1. Single bond 2. Double bond 3. Tripple bond. If we look at CDT representation of a sentence through the viewpoint of Semistry, we will recognize a Similarity between chemical molecules and CD structure. From this insight, we can make a analogy of semantic 'isomer', depending on a mode of bondage between the semantic primitives. For exsample, CD structure of PP(picture producer) and ACT (action) is represented in the Fig.2 in which two way dependency is interpreted as a double bond in case of Semistry. If one of the valence shifts to another pair of primitive as shown in Fig.2, then the structure is called semantic resonance.

In case of PP with the extra valence, some modifiers will be possible to link the activated part of PP. If the activation will occur at the ACT, the extra valence part will be embedded with the related case in CDT. Since it is not the purpose of the present paper to develop an impecable account of Semistry, let us take another example from a lexical item which is related to the present study.

In the analysis of lexical structure, words are not really defined in the standard dictionaries in any precise way in case of the human cognitive system. There are various means to be employed to indicate their meaning more or less vaguely, but these means are usually sufficient for the cognitive processing. They may be extralinguistic means (such as diagram) or linguistic definition, both explicit and implicit. Neither of these

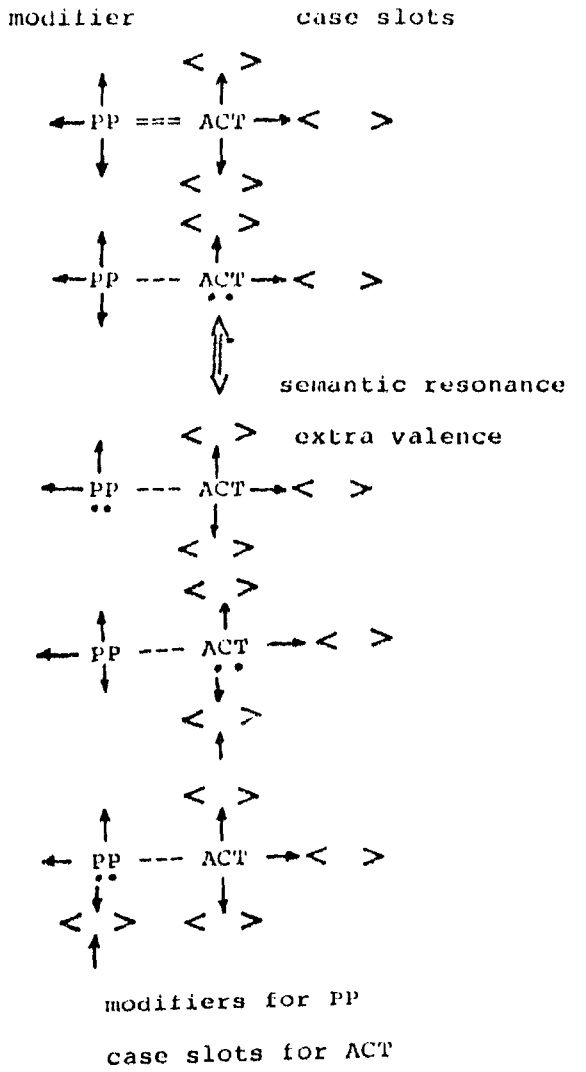

Fig. 2 View of Semistry into CD theroy for Semantic resonance representation.

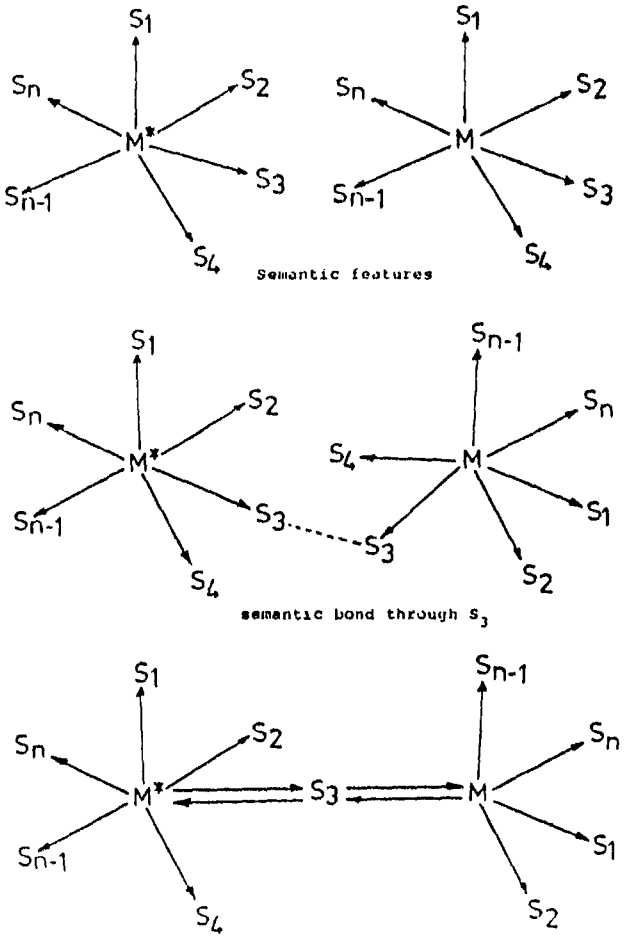

Fig.3 Representation of lexical item in semantic bond.

are of much use for the construction of metaphor processing system.

In case of metaphorical analysis, the lexical item must be defined with an inclusion of semantically unacceptable feature. This is represented by the following way as shown in Fig.3.

The format of lexical item is adapted by the use of distributed semantic links (or Single bonds) between words. That is, a word or lexical item is surrounded with semantic features S_1, S_2, ... S_n.

These bonds between word and semantic features are usually single bonds with homogeneous tention. In that case, the resonance is observed among the semantic features of word. In case of metaphorical semantic analysis, especially, noun-noun phase, the first noun modifies the second. So, the resonance is broken and the first noun in metaphorical relationship must include the meaning that is interpreted by the second.

Therefore, in order to determine the meaning of a noun phase, there must be an intersection of meaning between M* and M. If such intersection exsists between the first and the second, the double bond is constructed in the Fig.3. In this way, word definition can be turned by adding procedure for unacceptable semantic link. The process is regarded as semantic change of meaning from Semistry's viewpoint. The change of meaning in metaphor is classified by the following categorical transformation as is shown in Table 1.

Thus, the idea of Semistry is proposed so as to meet the present purpose of metaphor semantic analysis. The experimental system

1. From Object to Human
   Contextual transformation
   M* = Object M = Human

2. Bond between Object and Human
   Link transformation
   M* = Object M=Human

3. Transformation from Human body to Object, Location
   M* = Human body M = Object & Location

4. Animal & Location's Personification
   M* = Animal & Location
   M = Human

5. Pseudo-personification
   M* = Object & Animal & Location & Abstract
   M = personification's Object

6. From Abstract to Concrete Object
   M* = Abstract Object M = Concrete Object

Table 1. Metaphorical Transformation

called META-SIM is designed and tried out through the use of ELINGOL developed by Tanaka et al (1978).

3. Metaphor analysis of noun phrase

In this section, we show the case study based on the idea shown before. At the first stage, we analyzed a noun-noun metahpor using ELINGOL couped with production system designed with a viewpoint of standard control structure. The present studies focus on a noun-phrase in metaphorical use in Japanese, such as

I. Metaphor
   "noun + noun"

II. Simile
1. M* no m* SIM M no m.(m* of M* SIM m of M)
2. M* no m* SIM M(or m).(m* of M* SIM M(or m))
3. M*(or m*) SIM M no m.(M*(or m*) SIM m of M)
4. M*(or m*) SIM M(or m)

In the above notation, SIM represents a similarity between two nouns in Simile, and a noun denoted a small letter is a part of noun denoted a capital letter.

In this case study, we use a ELINGOL (Extended Linguistic Oriented Language) for the parser (systactic analyzer). The ELINGOL is a contex free parser extended at ETL, and it has a semantic processing parts that the user can write any semantic processing program in terms of LISP.

Dictionary

The description in dictionary used in this case study is as in Fig.4

Each dictionary item consists of four parts, the first is item of the word, the second is the syntactic category of the word, the third is the part used in case of some ambiguities,

```
(MOMIJI NOUN (NIL 0)
   '(MOMIJI
     UNIT
     (SELF SHOKUBUTSU)
     (PART-OF NIL)
     (SEM-FEATURE
        (SIZE = ***)
        (PART-OF-FEATURE (HA (SIZE = CHIISAI)))))  )

(TE NOUN (NIL 0)
   '(TE
     UNIT
     (SELF NIL)
     (PART-OF NINGEN)
     (SEM-FEATURE
        (SIZE = ***)
        (P-PROPERTY = ***)
        (META-NOUN (HA OF SHOKUBUTSU))))  )
```

Fig.4 Dictionary

the fourth is the part for knowledge representation which the word has. In this case study, the knowledge of each word is expressed in terms of SRL knowledge representation, as in Fig.4.

Here, the framework of knowledge representation is constructed by a set of semantic feature and properties, such as "TE (hand)" and "MOMIJI (maple)" in Fig.4. In the above representation, there are some special slots or semantic feature. The SELF slot represents a semantic category of the noun for the top node in part-whole relation network. PART-OF slot represents a upper node of the noun in part-whole relation network. In SEM-FEATURE, PART-OF-FEATURE represents some special feature of the components of the noun, and MATA-NOUN represents a restriction of the compared parts for the modifier noun category.

Grammar

The description in grammar used in this case study is as shown in Fig.5.

```
(NPK (NOUN JO) (NIL 0) (LG))
(NPP (NPK NOUN) (NIL 0) (CONS (LG) (LIST (RG))))
(IND (JO ADJV) (NIL 0) 0)
(NP1 (NPP IND) (NIL 0) (LG))
(NPN (NOUN IND) (NIL 0) (LG))
(NP (NOUN NOUN) (NIL 0) (NPSEM (LG) (RG)))
(NP (NPN NPP) (NIL 0) (MTSEM3 (LG) (RG)))
(NP (NP1 NPP) (NIL 0) (MTSEM1 (LG) (RG)))
(NP (NPN NOUN) (NIL 0) (MTSEM4 (LG) (RG)))
(NP (NP1 NOUN) (NIL 0) (MTSEM23 (LG) (RG)))
(NPL (NPK NP1) (NIL 0) (CONS (LG) (RG)))
(NP (NPL NOUN) (NIL 0) (MTSEM1 (CDR (LG))
                               (CONS (CAR (LG)) (LIST (RG)))))
(SENTENCE NP (NIL 0) (DG))
(SENTENCE (SENTENCE END) (NIL 0) (LG))
()
```

Fig.5 Grammar

Each grammar consists of four parts, the first and the second parts represent a contex free rule of A --- B (C), the third is used in case of some ambiguities, and in the fourth part, we describe any semantic processing procedures. In Fig.5, the fourth part describe a LISP function for metaphorical semantic processing which is considered in the next section.

Procedure for Metaphorical semantic processing

First, a input string must be parsed through ELINGOL and produce a parsing tree which is one of the control structure for semantic analysis.

In order to interprete a noun phrase, a meaning of a phrase is constructed by seeking the semantic relation between noun and noun in

the noun phrase. So, at first, two nouns to be interfered must be chosen, the choice is desided in terms of a syntactic structure and semantic part-whole relation network, because, in Japanese, there are many paraphrase only one noun phrase that has same meaning.

Then, a new semantic interpretation is obtained from a intersection which is accomplished through the search of the two noun definitions. When an intersection occurs, the system focuses the matched semantic features extracted in the search to construct an interpretation. Thus, the search process corresponds to the conflict resolution process to produce the "infered meaning". In this way, interpretation of metaphorical use is accomplished.

Here, we show the detailed semantic procedure for each cases shown before.

(I) noun-1 + noun-2, Metaphor

Top level function : NPSEM

Procedore :

By metaphorical interference between noun-1 and noun-2, metaphorical semantics is obtained from a intersection of semantic features between two nouns.

(II - 1) M* no m* SIM M no m, Simile

Top level function : MTSEM1

Procedure :

First, by comparing noun semantic between M* and m* to that of M and m, the system can decide the semantic of "M* no m*" and "M no m". Then metaphorical semantics is obtained by contrasting noun phrase semantic between the semantic of "M* no m*" and that of "M no m".

(II - 2) M* no m* SIM M(or m), Simile

Top level function : MTSEM23

Procedure :

First, by comparing two noun semantics between M* and m*, the system can decide the semantic of "M* no m*", then metaphorical semantic is obtained by contrasting the semantic between "M* no m*" and M(or m).

(II - 3) M*(or m*) SIM M no m, Simile

Top level function : MTSEM3

Procedure :

First, by comparing noun semantic between M and m, the system can decide the semantic of "M no m". In this type, noun phrase contrasting has three types. The first type is in case that m* of M* is omitted because of m*=m. In this case, by comparing noun semantic between M* and m* (=m), the system can decide the semantics of "M* no m*", and then, metaphorical semantics is obtained by contrasting noun phrase semantic between "M* no m*" and "M no m". The second type is in case that m* of M* is omitted but m* is restricted by META-NOUN description m*' of m. In this case, by comparing noun semantic between M* and m*', the system can decide the semantic of "M* no m*'", and then, metaphorical semantics is obtained by contrasting noun phrase semantic between "M* no m*'" and "M no m". The third type is other cases. In this case, by comparing semantic between M*(or m*) and that of "M no m".

(II - 4) M*(or m*) SIM M(or m), Simile

Top level function : MTSEM4

Procedure :

In this type, semantic procedure is as same as type (II - 3) without comparing noun semantic between M and m.

Results of case studies

Results of some case studies are shown in Fig.6, Fig.7, and Fig.8.

```
\MOCHIHADA.
                                        SENTENCE
                                           !
                      SENTENCE-------------------------------END
                         !                                    !
                        NP                                    !
                         !                                    !
              NOUN---------------NOUN                         !
                !                  !                          !
             MOCHI               HADA                         .
        *** METAPHORICAL INTERFERENCE ***
        (MOCHI
         UNIT
         (SELF JINKOUBUTSU)
         (PART-OF NIL)
         (SEM-FEATURE
                  (P-PROPERTY = NAMERAKA & YAWARAKA)
                  (COLOR = WHITE)
                  (WEIGHT = ***)
                  (TASTE = ***)
         ))
        (HADA
         UNIT
         (SELF NIL)
         (PART-OF DOUBUTSU)
         (SEM-FEATURE
                  (COLOR = ***)
                  (P-PROPERTY = ***)
         ))
        --- MATCHED SEMANTIC FEATURE ---
        P-PROPERTY  =====> (P-PROPERTY = NAMERAKA & YAWARAKA)
        --- MATCHED SEMANTIC FEATURE ---
        COLOR  =====> (COLOR = WHITE)
        --- RESULT OF METAPHOR ---
        (HADA
         UNIT
         (SELF NIL)
         (PART-OF DOUBUTSU)
         (SEM-FEATURE
                  (P-PROPERTY = NAMERAKA & YAWARAKA)
                  (COLOR = WHITE)
         ))
        246 MILLISECONDS.
```

Fig.6 Metaphor processing for "MOCHIHADA"

Result shown in Fig.6 is to deal with noun-noun metaphor "MOCHIHADA (a soft white skin)". The intersection occurs at the semantic feature's description, then the slot of "P-PROPERTY" is filled in the semantic feature of "MOCHI (rice cake)".

Next case study shown in Fig.7 is to deal with "MOMIJI NO YOUNA TE (hand like as maple)" known as "Simile".

Tree structure represents a result of parsing, and it is one of the control structure of semantic processes. In this semantic process, first, noun "MOMIJI (maple)" and "HA (leaf)" are interfered for noun phrase and produce a new unit which means "MOMIJI NO HA (leaf of maple)". Then, new unit "HA (leaf)" and noun "TE (hand)" of someone are interfered for metaphorical use, and produce a final result.

And, other case study "DAIKON NO YOUNA HANAKO NO ASHI (leg of HANAKO like as DAIKON)" and its paraphrase "HANAKO NO DAIKON NO YOUNA ASHI" are metaphorically analyzed into the same semantic structures shown in Fig.8 and Fig.9.

In this case, the syntactic analysis is much complex as is compared to the noun-noun phrase, and semantic process is as like as before.

```
@(HELLO)
        BUN WO IRE TE KUDASAI
\MOMIJINOYOUNATE.
                                        SENTENCE
                                           !
                          SENTENCE-----------------------------END
                             !                                  !
                             NP                                 !
                             !                                  !
                     NPN-------------------NOUN                 !
                      !                     !                   !
          NOUN-----------IND                !                   !
            !             !                 !                   !
            !         JO----ADJV            !                   !
            !         !     !               !                   !
        MOMIJI       NO    YOUNA            TE                  .
      *** NOUN PHRASE INTERFERENCE ***
      (MOMIJI
       UNIT
       (SELF SHOKUBUTSU)
       (PART-OF NIL)
       (SEM-FEATURE
                (SIZE = ***)
                (PART-OF-FEATURE (HA (SIZE = CHIISAI)))
       ))
      (HA
       UNIT
       (SELF NIL)
       (PART-OF SHOKUBUTSU)
       (SEM-FEATURE
                (SIZE = ***)
                (COLOR = ***)
                (KATACHI = ***)
       ))
      --- MATCHED SEMANTIC FEATURE ---
      SIZE  =====>(SIZE = CHIISAI)
      --- SEMANTICS OF    MOMIJI  NO  HA
      (HA
       UNIT
       (SELF NIL)
       ( PART-OF MOMIJI )
       (SEM-FEATURE
                (SIZE = CHIISAI)
                (COLOR = ***)
                (KATACHI = ***)
       ))
      *** METAPHORICAL INTERFERENCE ***
      (HA
       UNIT
       (SELF NIL)
       ( PART-OF MOMIJI )
       (SEM-FEATURE
                (SIZE = CHIISAI)
                (COLOR = ***)
                (KATACHI = ***)
       ))
      (TE
       UNIT
       (SELF NIL)
       (PART-OF NINGEN)
       (SEM-FEATURE
                (SIZE = ***)
                (P-PROPERTY = ***)
                (META-NOUN (HA OF SHOKUBUTSU))
       ))
      --- MATCHED SEMANTIC FEATURE ---
      SIZE  =====>(SIZE = CHIISAI)
      --- RESULT OF METAPHOR ---
      (TE
       UNIT
       (SELF NIL)
       (PART-OF NINGEN)
       (SEM-FEATURE
                (SIZE = CHIISAI)
                (P-PROPERTY = ***)
                (META-NOUN (HA OF SHOKUBUTSU))
       ))
      971 MILLISECONDS.
```

Fig.7 Metaphor processing for "MOMIJI NO YOUNA TE"

```
\DAIKONNOYOUNAHANAKONOASHI.
                                        SENTENCE
                                           !
                          SENTENCE-----------------------------ENI
                             !                                  !
                             NP                                 !
                             !                                  !
                     NPN-------------------NPP                  !
                      !                     !                   !
          NOUN---------IND            NPK--------NOUN           !
            !             !             !         !             !
            !         JO----ADJV     NOUN----JO    !             !
            !         !     !        !       !     !             !
        DAIKON       NO    YOUNA    HANAKO   NO    ASHI          .
      *** NOUN PHRASE INTERFERENCE ***
      (HANAKO
       UNIT
       (SELF NINGEN)
       (PART-OF NIL)
       (SEM-FEATURE
                (SEI = ONNA)
                (M-PROPERTY = ***)
       ))
      (ASHI
       UNIT
       (SELF NIL)
       (PART-OF DOUBUTSU)
       (SEM-FEATURE
                (HUTOSA = ***)
                (NAGASA = ***)
       ))
      --- SEMANTICS OF    HANAKO  NO  ASHI
      (ASHI
       UNIT
       (SELF NIL)
       ( PART-OF HANAKO )
       (SEM-FEATURE
                (HUTOSA = ***)
                (NAGASA = ***)
       ))
      *** METAPHORICAL INTERFERENCE ***
      (DAIKON
       UNIT
       (SELF SHOKUBUTSU)
       (PART-OF NIL)
       (SEM-FEATURE
                (HUTOSA = HUTOI)
                (COLOR = WHITE)
       ))
      (ASHI
       UNIT
       (SELF NIL)
       (PART-OF DOUBUTSU)
       (SEM-FEATURE
                (HUTOSA = ***)
                (NAGASA = ***)
       ))
      --- MATCHED SEMANTIC FEATURE ---
      HUTOSA  =====>(HUTOSA = HUTOI)
      --- RESULT OF METAPHOR ---
      (( *GEN0000 . HANAKO )
       UNIT
       (SELF NINGEN)
       (PART-OF NIL)
       (SEM-FEATURE
                (SEI = ONNA)
                (M-PROPERTY = ***)
       ))
      (ASHI
       UNIT
       (SELF NIL)
       ( PART-OF *GEN0000 )
       (SEM-FEATURE
                (HUTOSA = HUTOI)
                (NAGASA = ***)
       ))
      1282 MILLISECONDS.
```

Fig.8 Metaphor processing for "DAIKON NO YOUNA HANAKO NO ASHI"

```
\HANAKONODAIKONNOYOUNAASHI.
                                    SENTENCE
                                       !
                          SENTENCE-------------------------------END
                             !                                     !
                            NP                                     !
                             !                                     !
                      NP1---------------------NOUN                 !
                       !                       !                   !
              NPP---------------IND            !                   !
               !                 !             !                   !
          NPK-------NOUN         !             !                   !
           !         !           !             !                   !
       NOUN----JO    !      JO----ADJV         !                   !
         !     !     !       !     !           !                   !
      HANAKO   NO  DAIKON   NO   YOUNA        ASHI                 !
     *** NOUN PHRASE INTERFERENCE ***
     (HANAKO
      UNIT
      (SELF NINGEN)
      (PART-OF NIL)
      (SEM-FEATURE
              (SEI = ONNA)
              (M-PROPERTY = ***)
      ))
     (ASHI
      UNIT
      (SELF NIL)
      (PART-OF DOUBUTSU)
      (SEM-FEATURE
              (HUTOSA = ***)
              (NAGASA = ***)
      ))
     --- SEMANTICS OF    HANAKO  NO  ASHI
     (ASHI
      UNIT
      (SELF NIL)
      ( PART-OF HANAKO )
      (SEM-FEATURE
              (HUTOSA = ***)
              (NAGASA = ***)
      ))
     *** METAPHORICAL INTERFERENCE ***
     (DAIKON
      UNIT
      (SELF SHOKUBUTSU)
      (PART-OF NIL)
      (SEM-FEATURE
              (HUTOSA = HUTOI)
              (COLOR = WHITE)
      ))
     (ASHI
      UNIT
      (SELF NIL)
      (PART-OF DOUBUTSU)
      (SEM-FEATURE
              (HUTOSA = ***)
              (NAGASA = ***)
      ))
     --- MATCHED SEMANTIC FEATURE ---
     HUTOSA  =====>(HUTOSA = HUTOI)
     --- RESULT OF METAPHOR ---
     (( *GEN0001 . HANAKO )
      UNIT
      (SELF NINGEN)
      (PART-OF NIL)
      (SEM-FEATURE
              (SEI = ONNA)
              (M-PROPERTY = ***)
      ))
     (ASHI
      UNIT
      (SELF NIL)
      ( PART-OF *GEN0001 )
      (SEM-FEATURE
              (HUTOSA = HUTOI)
              (NAGASA = ***)
      ))
     742 MILLISECONDS.
```

Fig.9 Metaphor processing for "HANAKO NO DAIKON NO YOUNA AHI"

These cases are selected from the book called "A Stylistic Study of the Figuratives" (Nakamura, 1977). At the present state, number of items in dictionary is about 150.

4. Summary and conclusions.

We have dealt with conflict resolution process in metaphorical interpretation for noun phrases. In order to make the discussion more explicit, we have reviewed the problem on conflict resolution both from cognitive psychology and artificial intelligence. Especially, we have made our attention to the problem of knowledge representation in human long-term memory and AI system. In this connection, the procedure for dealing with semantically unacceptable knowledge is stressed for the understanding of metaphor. That is, we have considered the dynamic aspect of meaning for word or lexical item in metaphor. In order to penetrate the problem on representation of meaning in metaphor, the idea of "Semistry" is introduced so as to analyze the conflict resolution in semantic interpretation. The idea of Semistry has been derived from the notion of Zwicky's paper on "Linguistics as Chemistry" which is metaphorical interpretation on Chemistry. By applying the notion into semantic structure of lexical item, the dynamic aspect of meaning is explaind by introducing the idea of "semantic bonds" which have further constructed semantic resonance among semantic features. A usual meaning is determined from the single bonds between word and semantic features. In order to determine the meaning of noun-noun phrase metaphor, there must be an intersection of meaning between the first and the second nouns. This kind of intersection is accomplished through the procedure for finding the matched semantic properties of the first and the second nouns.

The proposed semantic model is designed and tried out for dealing with the noun phrase metaphor through the use of ELINGOL. Here, by parsing tree and LISP function in grammar, the inference system to resolve the conflict of semantic interpretation of metaphor was constructed. That is, the metaphor processing system would comprise a lexical item or word and associated inference mechanism to extract the meaning of metaphor. In order to proof the idea, the working system for the noun phrase is implemented by means of UCI-LISP (DEC-20) or HLISP (HITAC 8800-8700) and tried out with case studies.

As the conclusions, we have shown a possibility for approaching a semantic analysis of metaphor from an actual working system.

First, a new semantic model is proposed for dealing with metaphor. The idea of semantic resonance is introduced to explain "semantic bonds" which is derived from the comparison with Linguistic as Chemistry. Therefore, a role of metaphor is demonstrated in the present semantic model.

Second, the ELINGOL is utilized to unify the syntactic processing with the associated inference mechanism to extract metaphorical interpretation.

Third, metaphor processing system called META-SIM is designed and tried out through case studies. We have discussed our experiences which was based upon the results of working system for metaphor processing system.

Although the present system and case studies are restricted to the noun-noun phrase, the meaning of smaller phrase can be useful to build up semantic analysis of larger phrase of metaphor. In this sense, the present study is the first step toward the semantic analysis of metaphor which has not been explored in the natural understanding system. And further, the study of metaphor will give us about much more fruitful inference mechanism for interpreting semantically unacceptable sentence. In the future, the role of metaphor must investigate for both educational purpose and design philosophy of any understanding system.

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