Control in Situation Semantics

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I. Introduction: Lexicon and Rule Application Algorithm

In Situation semantics, the meaning of an utterance is the relation (or condition) between the utterance situation and the described events. For example, an utterance of "I am standing." is true iff the utterer is standing at the time of the utterance. Perry (1983) explains this relation as follows:

(1) u [[I am standing]]e iff there is an individual 'a' and a location '1' such
that in u, at 1, utters, a, I am standing: yes
In e, at 1, stands, a: yes

Barwise (1984) also represents types of situations exclusively in terms of their internal structure. Consider the type SIT. of situation where someone is standing. We can think of this type, in terms of the type SIT. of situation together with a condition C. on this type, the condition that someone is standing at some location. It is natural to classify this condition abstractly in terms of SIT, IND, LOC and the property of standing:

(2) In SIT: at LOC: standing, an IND: 1

The basic type SIT, LOC and IND are indeterminates which are the semantic features of an expression 'standing'.[1] Thus the meaning of an expression 'standing' will place conditions on the semantic values that can be assigned to semantic features. However, Barwise (1984) doesn't introduce the concrete syntactic analysis.

Pollard (1985) says that the language is the shared psychological system that mediates between utterance types and the things they describe. Pollard (1985) represents the lexical entry for an expression 'sees' in the following form:

```
(3) [PHONOLOGY  =  SEES
     SEMANTICS  =  [PROPERTY  = SEE
                    AGENT     = X1
                    PATIENT   = X2 ]
     SYNTAX     =  [MAJ       = V
                    VFORM     = FIN
                    SUBCAT    = <NP: X2, NP-3s: X1> ] ]
```

However, the property (event-type) of being an event of seeing is not the condition on the situation type. We modify the lexical form as follows:

```
(4) [PHONOLOGY  =  SEES
     SYNTAX     =  [MAJ       = V
                    VFORM     = FIN
                    SUBCAT    = <NP, NP-3s> ]
     SEMANTICS  =  C: In SIT: at LOC: see, IND1, IND2: POL
                   In SIT. TEMP: O, LOC, LOC-UTT: 1
                   where IND1 = Agent, IND2 = patient. ]
```

The phonology in (4) indicates the internal phonological representation of the utterance of the word'sees'. The syntax in (4) represents the syntactic category with a set of attribute-value pairs. The semantics in (4) represents the conditions on the situation type of seeing at the location which is constrained to temporally overlap that of the utterance. Agent and Patient is the role of the individual type.

Now let us consider the following example.

```
(5)           S:3
           /       \
        NP:1       VP:2
         |           |
        John       walks
```

The relevant constituents are NP:1 'John' and VP:2 'walks'. The semantic features of NP:1 are SIT. 1, LOC. 1 and IND. 1 and those of VP:2 are SIT. 2, LOC. 2 and IND. 2. They have the following lexical forms:

```
(6) a. [PHONOLOGY  =  JOHN
        SYNTAX     =  [MAJ     = N
                       AGR     = 3s
                       SUBCAT  = <EMPTY> ]
        SEMANTICS  =  C.1: In SIT.1: at LOC.1: John, IND.1: 1 ]
```

b. [PHONOLOGY = WALKS
SYNTAX = [MAJ = V
VFORM = FIN
SUBCAT = <NP-3s>]
SEMANTICS = C.2: In SIT. 2:at LOC. 2: walk, IND.2:1
In SIT. TEMP: O,LOC.2, LOC-UTT:1
where IND.2 = Agent]

We need grammar rules to create more complex signs that mediate between longer utterance types and more complex aspects of the situation types. Pollard (1985) introduces the following rules:

(7) a. ——— C H [Condition: length of SUBCAT of H = 1]
b. ——— H C [Condition: length of SUBCAT of H = 2]
c. ——— H C2 C1 [Condition: length of SUBCAT of H = 3]

The symbols 'H' and 'C' are meta grammatical symbols that are mnemonic for head and complement. In plain English, rule (7a) means:

(8) If H is a sign whose SUBCAT value contains a single category X and C is a sign whose category unifies with X, then we can form a new sign whose phonology is got by concatenating the phonologies of C and H from left to right.

Thus the rule (7a) allows us to construct a sign with the phonology ''John walks.' from (6). However, the rules (7) don't say anything about how to compute the syntax and semantics of the mother constitutent 'S:3 John walks' (only the phonology). Pollard (1985) introduces the following syntactic rule application algorithm.

(9) Rule Application Algorithm
1. Construct the mother from the daughters starting with the head H and proceeding through the complements C1, ... Ci, ... doing the following:
   a. (Subcategorization)
   Pop the top category from the SUBCAT of H and merge it into Ci. If merging fails, then fail (the rule does not apply)
2. (Head Feature Principle)
The values of the head features on the mother are the same as those on the head daughter.

For present purposs, all features are head features. Notice the use of the operation 'merge'. This is basically destructive unification operation: merging X into Y means linking the informations of X to those of Y.

Before introducing the semantic part of the rule application algorithm, we need to say a little about the system of semantic representation. Pollard (1985) thinks that semantic representation should be thought of as a partial description of some aspect of reality. But we think that it is a system of conventional constraints on the use of language: the condition on the situation type introduced by Barwise (1984). The meaning of a sentence is built up from the meaning of the parts of the sentence and the structure of the sentence. Therefore the semantics of the mother constituent is the union of those of the daughters plus the equation condition according to the following structural combination principle:

(10) Head Complement Linking Principle

The semantic features of the complement must be linked with those of the head according to the semantic relation between head and complement.

Thus the semantic part of Rule Application Algorithm is:

(11) Semantic Interpretation Principle

The semantics of the mother is the union of those of the daughters plus the conditions according to the following principles;

a. Head Feature Principle. (HFP)
b. Head Complement Linking Principle. (HCLP)

To illustrate the Rule Application Algorithm, let us consider the example (5) again. We follow the Rule Application Algorithm (9), starting with the subcategorization principle. Popping the top of the SUBCAT stack of H and merging into C has the effect of linking the informations of H to those of C. Next we consider the Semantic Interpretation Principle (11). The mother constitutent is S:3. The Semantic features of the sentence are SIT and LOC. The resulting mother has the following form:

```
(12) [PHONOLOGY  =  JOHN-WALKS                              ]
     [SYNTAX     =  [MAJ     =  V        ]                  ]
     [              [VFORM   =  FIN      ]                  ]
     [              [SUBCAT  =  <EMPTY>  ]                  ]
     [SEMANTICS  =  C.3  =  C.1 U C.2 plus                  ]
     [                      SIT.3  = SIT.2   (HFP)          ]
     [                      LOC.3 = LOC.2  (HFP)            ]
     [                      IND.1  = IND.2  (HCLP)          ]
```

The equation conditions SIT.3 = SIT.2 and LOC.3 = LOC.2 are obtained from HFP and IND.1 = IND.2 is obtained from HCLP.

II. Obligatory Control

Now let us consider the following obligatory control.

(13) a. Kim tries to go.
  b. Kim promises Lee to go.
  c. Kim persuades Lee to go.

Chierchia (1984) represents the six properties of the obligatory control construction.

First, the relation between the controlling NP and the controlled verbal argument is strictly local.

Second, the understood subject of the constructions in question can never receive an arbitrary (i.e. generic or contextually specified) interpretation.

Third, the controlling NP is thematically uniquely determined.

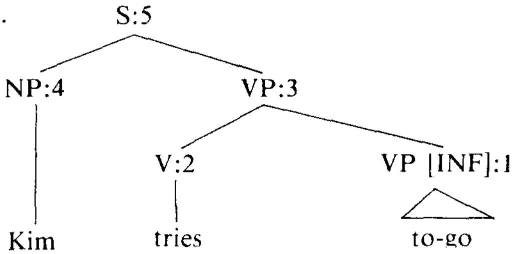
Fourth, the controlled verbal argument can't have more one controlling NP.

Fifth, there has to be a controller.

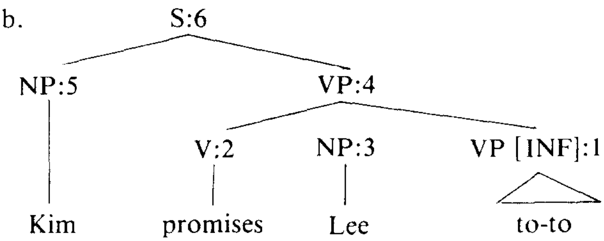
Sixth, there are two important generalizations: Visser's generalization concerns the impossiblity of passivizing subject control verbs and Bach's generalization concerns the impossibility of detransitivizing object control verbs.[2]

The examples in (13) are analyzed as follows:

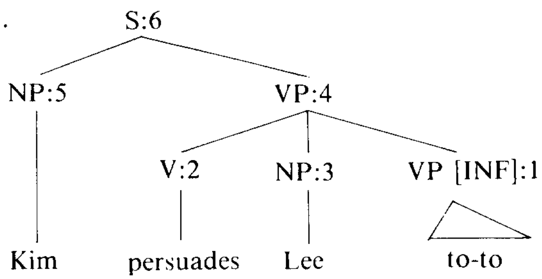
(14) a.



b.



c.



The lexical entry of the control complement "to-go" has the forms:

(15)
PHONOLOGY = TO-GO
SYNTAX = [MAJ = V
VFORM = INF]
SEMANTICS = C.1: In SIT.1: at LOC.1: go, IND.1:1
where IND.1 = Agent.

Let us consider the lexical entry of the verb "tries".

(16)
PHONOLOGY = TRIES
SYNTAX = [MAJ = V
VFORM = FIN
SUBCAT = <VP-INF, NP-3s>]
SEMANTICS = C.2: In SIT.2:at LOC.2: try, IND.2, SIT2.2: 1
In SIT, TEMP: O, LOC.2, LOC-UTT:1
where IND.2 = Source, SIT2.2 = Theme.

We apply the rule (7b) to obtain the VP:3 'tries to'-go'. When we pop the top category from the SUBCAT stack of H and merge it into the complement according to the subcategorization Principle,[3] the semantic features of the complement must be linked to those of the head. But the complement is a control complement and the controller is thematically uniquely determined. Culicover and Wilkins (1986)'s thematic condition is revised as follows:[4]

(17) Thematic Condition of Control
a. If the control complement is a Theme, then the controller must be a Source.
b. If the control complement is a Goal, then the controller must be a Theme.

According to the thematic condition (17a), we obtain the control condition IND.2 = IND.1 in the case of the verb 'try', because IND.2 is a Source and the control complement is a Theme. The semantic features of the VP constitutent are SIT, LOC, and IND. The completed VP:3 'tries to go' has the follwoing form:

```
(18)[PHONOLOGY  =  TRIES-TO-GO
    SYNTAX     =  [MAJ     = V
                   VFORM   = FIN
                   SUBCAT  = <NP-3s>]
    SEMANTICS  =  C.3 = C.1 U C.2 plus
                        SIT.3 = SIT1.2
                        LOC.3 = LOC.2 = LOC.1
                        IND.3 = IND.2 = IND.1
                        SIT2.2 = SIT.1              ]
```

The conditions SIT.3 = SIT1.2, LOC.3 = LOC.2 and IND.3 = IND.2 are obtained from HFP. The conditions LOC.2 = LOC.1, IND.2 = IND.1 and SIT2.2 = SIT.1 are obtained from HCLP. Especially the control condition IND.2 = IND.1 is obtained from the thematic condition of control (17a). We next apply the rule (7a) with (18) as a head and NP constituent 'kim' as a complement. This is straightforward as illustrated in section 1. The semantic features of a sentence are SIT and LOC. The resulting mother is:

```
(19)[PHONOLOGY  =  KIM-TRIES-TO-GO
    SYNTAX     =  [MAJ     = V
                   VFORM   = FIN
                   SUBCAT  = <EMPTY>]
    SEMANTICS  =  C.5 = C.4 U C.3 plus
                        SIT.5 = SIT.3
                        LOC.5 = LOC.3
                        IND.3 = IND.4               ]
```

The conditions SIT.5 = SIT.3 and LOC.5 = LOC.3 are obtained from HFP and the condition IND.3 = IND.4 from HCLP. From the condition IND.3 = IND.2 = IND.1 in (18) and the condition IND.3 = IND.4 in (19), we finally obtain IND.4 'kim' as the controller. This is the condition on the situation type.

Now let us consider the (14b) and (14c). The verb 'promise' is a subject control verb and the verb 'persuade' is a object control verb. They have SIT 1, LOC, IND 1, IND 2 and SIT 2 as the semantic features. They have the following lexical forms:

```
(20) a. [PHONOLOGY  =  PROMISES
         SYNTAX     =  [MAJ     = V
                        VFORM   = FIN
                        SUBCAT  = <VP-INF, NP, NP-3s>]
         SEMANTICS  =  C.2: In SIT1.2: at LOC.2: promise,
                            IND1.2, IND2.2, SIT2.2:1
                            In SIT.TEMP: O, LOC.2, LOC-UTT:1
                            where IND1.2 = Source,
                                  IND2.2 = Goal,
                                  SIT2.2 = Theme.                ]

     b. [PHONOLOGY  =  PERSUADES
         SYNTAX     =  [MAJ     = V
                        VFORM   = FIN
                        SUBCAT  = <VP-INF, NP, NP-3s>]
         SEMANTICS  =  C.2: In SIT1.2: at LOC.2: persuade,
                            IND1.2, IND2.2, SIT2.2:1
                            In SIT. TEMP: O, LOC.2, LOC-
                            UTT:1
                            where IND1.2 = Source
                                  IND2.2 = Theme
                                  SIT2.2 = Goal.                 ]
```

When we pop the top category from the SUBCAT stack of the Head and merge it into the complement according to the subcategorization principle, the semantic features of the control complement must be linked to those of the head. The control condition is defined according to the thematic condition of control (17).

(21) a. IND1.2 = IND.1 (promise)
b. IND2.2 = IND.1 (persuade)

In the case of 'promise', the controller is IND1.2 which plays a Source role because the control complement is a Theme. In the case of 'persuade' the controller is IND2.2 which plays a Theme role because the control complement is a Goal. Finally, IND.5:Kim is defined as the controller from the condition IND1.2 = IND5 in the case of 'promise' and IND.3:Lee is defined as the controller from the condition IND2.2 = IND.3 in the case of 'persuade'. These are the conditions on the situation types. Thus the controller of the obligatory control construction can be captured as the conditions on the situation type semantically. We don't have to postulate the syntactic empty category PRO because the semantic features of the control complement can do this function. We don't have to depend on the meaning postulate as in GPSG because the controller can be captured as the condition on the situation type.[5]

III. Non-obligatory Control

3.1 Semi-obligatory control

Now let us consider the following examples.

(22) a. Kim decided to go.
b. Kim signalled Lee to go.
c. To go is difficult for Kim.

The examples in (22) have the properties of the obligatory control construction. However, the controlling NP appears to be optional. Consider the examples (23):

(23) a. It was decided to go.
b. Kim signalled to go.
c. To go is difficult.

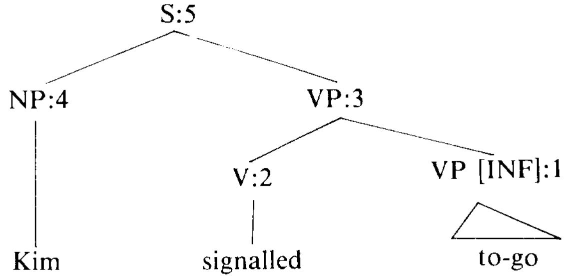
An immediate consequence of this optionality is that they provide counter example of Visser's and Bach's Generalization. In (23), we have a subject control verb that does passivize contra Visser. In (23b), we have an object control verb that does undergo detransitivization contra Bach. Compare the following obligatory control cases:

(24) a. *It was tried to go.
b. *Kim persuaded to go.

Chierchia (1984) calls them semi-obligatory controlled predicates. What seems to be the crucial point of semi-obligatory control is that the controlling NP appears to be optional. If a thematically determined argument is present, then it obligatorily controls the verbal argument. However, this argument may not be overtly present but rather implicit understood. In the latter case, it can receive an arbitrary interpretation (i.e. generic or contextually specified interpretation).[6]

Let us consider the latter case (23b). It can be analyzed as follows:

(25)



The lexical entry of V:2 'signalled' is:

(26)
PHONOLOGY = SIGNALLED
SYNTAX =
  MAJ = V
  VFORM = FIN
  SUBCAT = <VP-INF, NP-3s>
SEMANTICS = C.2:In SIT1.2:at LOC.2: signal, IND1.2, IND2.2 SIT2.2:1
  In SIT. TEMP: LOC.2<LOC-UTT:1
  where IND1.2 = Source,
  IND2.2 = Theme,
  SIT2.2 = Goal.

The subcategorization of the verb 'signal' in (26) is not <VP-INF, NP, NP-35> but <VP-INF, NP-35> because it does undergo detransitivization. But it has the same semantic features as the ordinary case in (22b). We apply the rule (7b) to obtain VP:3 'signalled to-go'. If we follow the Rule Application Algorithm and Thematic Control Condition, we obtain the following control condition.

(27) IND2.2 = IND.1

In the obligatory control case just like the verb 'persuade' in (13c), the semantic feature 'IND2.2' must be obligatorily present as a concrete individual. But in the case of semi-obligatory control just like the verb 'signal', the semantic feature IND2.2 may not be overtly present as in the case (25). In that case, the semantic feature IND2.2 remains a parameterized indeterminate in the condition on the situation type. Therefore we obtain the arbitary interpretation according to the condition on location, the speaker's connection and the discourse situation.

3.2 Prominence Control

Besides the semi-obligatory control, there is a prominence control as the non-obligatory control. Let us consider the following examples:

(28) a. John told me that to finish her/*my/*his work was difficult for Mary.
b. John told me that to finish her/my/his work was important for Mary.

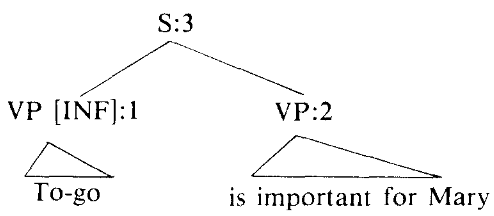
The example in (28a) is a semi-obligatory control case as illustrated in the previous section, but the example in (28b) is a prominence control case. The infinitival argument in embedded subject position can be controlled by an argument which occurs in some superdinate position. It can be some NP in the local environment of the predicate, some NP in main clause or in the preceding discourse. Notice that the controlling NP doesn't have to be the first NP in the local domain or the first c-commanding NP. All that seems to be required is that the controller be somehow sufficiently prominent. 'Prominence' seems to be the sole criterion. The controller is not thematically uniquely determined but contextually or even extra linguistically specified.

(29) I know that my wife is courageous and adventurous.
But to get herself into such a dangerous spot really scared me

In our approach, it can be explained as the meaningful option determined by the discourse situation and the speaker's connection from the factual situation type described by the linguistic expression.[7]

Let us consider the following example:

(30)



The control complement 'VP [INF]:1' has the same lexical form as discussed in the previous section. The control condition is usually defined when the control complement is combined with the head 'VP:2' according to the thematic condition of control. But in prominence control, the controller is not thematically determined but contextually specified as the prominent entity. In the example (30), the strong candidate for the role of the controller is the dative complement 'Mary' because being in the same local environment makes an NP quite prominent as the controller. But the examples in (28b) shows that the locality is by no means sufficient to license control. So we think that such a case is one possible actual situation as a meaningful option specified or anchored by the discourse situation and the speaker's connection. But this is not the factual situation containing the only conditions described by the linguistic expression but the actual situation as a meaningful option. We can think of another case which isn't controlled by the dative complement 'Mary' as a meaningful option. In that case, the semantic feature of control complement 'IND.1' is not specified but remains a parameterized indeterminate. Therefore we can obtain the arbitrary interpretation specified by the discourse situation and the speaker's connection.

Let us consider the following examples:

(31) a. To dance is fun.
 b. To dance was fun.

Since the simple present is usually understood as generic, the example (31a) will be interpreted as saying something about activitity of dancing in general but not a particular dancing event where a certain contextually specified person dances.[8] It can be explained as the unlocated individual type concerned with the state of affair. On the other hand, the example (31b) seems to be ambiguous. It can be interpreted as a generic or an episodic reading. In the latter reading, it can be explained as the located individual type concerned with the event.[9]

IV. Conclusion

We have discussed three points: Rule Application Algorithm, Obligatory control and Non-obligatory control. There are three advantages in our approach.

First, there is no need to postulate the phonetically unrealized element like PRO because the semantic feature of control complement, IND type, can do this function. So we can treat it semantically.

Second, we don't have to depend on the meaning postulate in order to explain the obligatory control. In our approach, the control condition is defined according to the thematic condition of control while in GPSG, the understood subject of the control complement is captured in a semantic entailment by the meaning postulate associated with the control verb.

Third, we can treat both obligatory control and non-obligatory control within the framework of situation semantics. In obligatory control, the understood subject of the control complement is captured as the equation condition between the individual types which are the semantic features of each constituent. In non-obligatory control, it is explained as the parameterized indeterminate which is the semantic feature of control complement.

Note.

1. Barwise (1984:5) explains this term as follows:

"Our basic idea here is that each expression α, used as an expression of a particular category, say A, has associated with it a condition. We call these parameters semantic features."

2. The terms Visser's Generalization and Bach's Generalization are called by Bresnan (1982).

3. Pollard (1985) introduces the following Control Agreement Principle:

Control Agreement Principle

If Ci is controlled, then pop the top category from the SUBCAT of C and merge it into the category currently on top of H's SUBCAT stack. If merging fails, then fail (the rule does not apply).

This agreement principle is derived from Bach and partee (1980)'s following generalization based on Rosenbaum (1967)'s Minimal Distance principle;

"The first NP argument to combine with a functor in which a VP occurs is the semantic controller of that VP."

But Pollard's control principle and the control principle in GPSG including Bach and partee's generalization are criticized in Kim (1986).

4. Culicover and Wilkins (1986;125) introduces the following Thematic condition on R-Structure.

Thematic condition on R-structure Coindex R (NP) and R (X) where X is a predicate.

(i) If R (X) bears no thematic role, then R (NP) must be a Theme or a Source.

(ii) If R (X) is a Goal, then R (NP) must be a Theme.

(iii) If R (X) is a Theme, then R (NP) must be a Source.

5. Gazard et al. (1985) adopts the semantic interpretation function 'f_E' and the following meaning postulate:
   $\forall V \forall P_1 \ldots Pn \Box [f_E (\zeta) (V) (P_1)\ldots (Pn) \leftrightarrow$
   $P_1 [\lambda\chi [V (x^*)) (x^*) (P_2)\ldots (Pn)]]]$
   where P is of NP type and n>1
6. Chierchia (1984) translates the example (25) as follows:
   a. DTRANS' (Signal') (ĝo) (K)
   b. ∃ y [Signal' (ĝo) (y) (k)]
7. Barwise (1984) introduces the axiom 4:
   Axion 4: Every factual abstract situation S_0 is a subset of some actual abstract situation
8. Chierchia (1984) translates the examples (31) as follows:
   1) Gn (fun′) (∂ance) (Gn: generice tense operator)
   2) H [∃y fun′(y) (∂ance′)] (H: past tense operator)
9. Barwise (1984) introduces the axiom 3:
   Axiom 3: There are located and unlocated facts.

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