

Syntax and Semantics of Anaphoric Relations in the Relative Clause*

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0. Introduction

This paper aims to provide a solution for the problem of the structural circularity in a restrictive relative clause in English. After discussing the characteristic property of a restrictive relative clause, I will make a suggestion to the effect that the inherent property will be accommodated into the syntactic rules and their corresponding semantic translations.

In section 1, I will discuss the so-called circularity problem in the relative clause. In section 2, several analyses of the structure of the restrictive relative clause will be critically reviewed. Then, in section 3, I will observe some characteristic properties of a restrictive relative clause, which will be used in solving the circularity problem. In section 4, I will suggest a solution, which will be based upon the observed properties. The solution will be represented in terms of a condition on the input of the relativization rule. In section 5, this syntactic condition will be reflected in the semantic translation.

1. Circularity problem

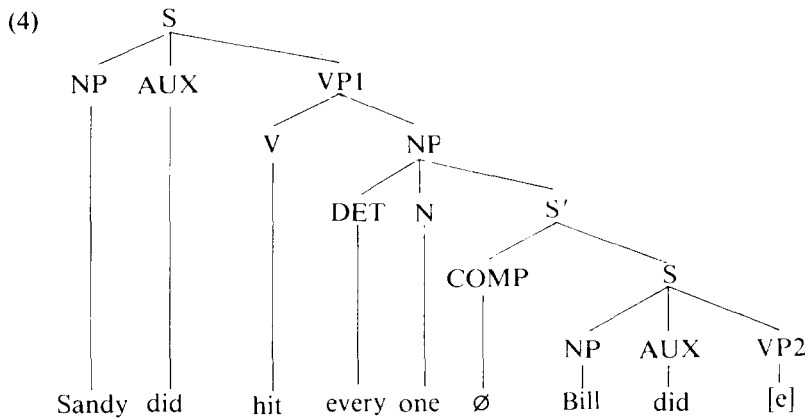
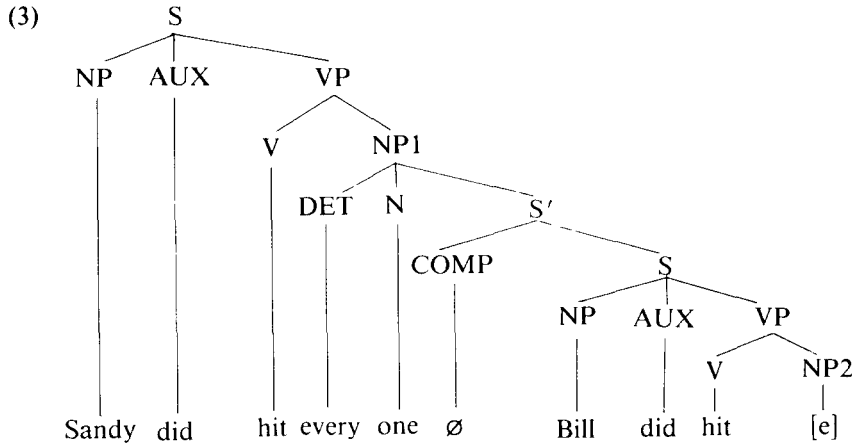
According to the traditional transformational grammar, the restrictive relative clause has an empty category. It is a trace left by the WH-phrase moved to the COMP position. For example, let us see sentence (1) and (2).

(1) Sandy hit everyone Bill (did) hit [e].

(2) Sandy hit everyone Bill did [e].

Sentence (1) is derived by the relativization rule and the WH-phrase deletion rule. Sentence (2) is obtained by the rules of relativization, WH-phrase deletion and verb deletion. In other words, sentence (2) is derived from

sentence (1) by deleting 'hit'. Sentence (1) and (2) can be represented in the tree diagrams as follows;



Structurally, the implicit argument for the empty category NP2 in (3) is understood to be $[_{NP1}$ everyone Bill did hit $[_{NP2}$ e]]. In (4), what is supposed to replace the empty category VP2 is understood to be $[_{VP1}$ hit everyone Bill did $[_{VP2}$ e]].¹

Brody (1982) introduces the circularity problem by analyzing sentence (2) as follows;²

(5) Sandy $[_x$ hit everyone Bill did $[_y \emptyset]$

(6) [_y everyone Bill did \emptyset] → Sandy [_yhit y]

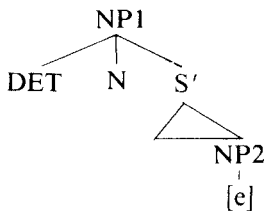
While expression (5) is the form before the rule Quantifier Raising is applied, expression (6) is derived by the application of the rule Quantifier Raising. In (5) and (6), the variables show the anaphoric dependency. In (4), an apparent circularity problem arises if we assume that the empty category VP2 semantically denotes the whole category VP1. That is, expression (5) is circular by ‘X-within-X’, and expression (6) is circular by ‘Y-within-X and X-within-Y’.

In this paper it will be made clear that the understood argument filled in the empty category in sentence (1) is not identical with the head NP nor with the head NP plus the relative clause. In order to provide a proper treatment of this phenomenon, this paper will adopt an extended version of the transformational Montague grammar, incorporating the revisions suggested in such works as Barbara H. Partee (1973, 1979), Robert Rodman (1976) and Emmon Bach and Robin Cooper (1978).³

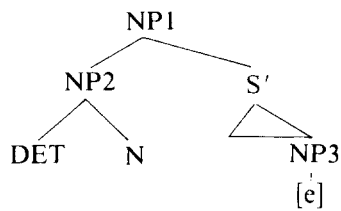
2. Analyses of the structure

While Chomskyan transformational grammarians use the method of the ‘topdown’ derivation of sentences, Montague grammarians build up the sentences from parts to the whole, namely, the ‘bottom-up’ derivation. One problem we may encounter in the ‘bottom-up’ derivation is the decision of the immediate constituents. There are several possibilities of concatenating the determiner, the head noun and the embedded clause to make a complex noun phrase with a relative clause. Let us see (7).⁴

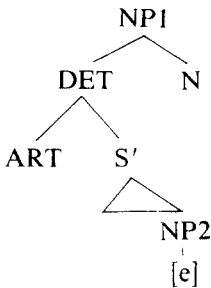
(7) a.



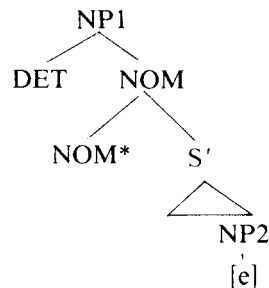
b.



c.



d.



(7a) is generated by a phrase structure rule ($NP \rightarrow DET N S$) in the transformational grammar. *N* is a head noun, and *DET* and *S* are complements. These three constituents are sisters to each other. (7b) is the so-called ‘NP-analysis’ which Bach and Cooper (1978) suggests. (7c) shows that *S* is combined with the article first, and then the newly generated determiner is combined with the head noun. But intuitively this concatenation appears to be ad hoc. (7d) is an analysis widely assumed among Montague grammarians, which is called ‘Nom-analysis’.

Now, what is the antecedent of an empty category in the configurations in (7)? According to the binding theory in LGB, an antecedent must C-command the empty category. In (7a) the antecedent of NP2 is a WH-phrase in *COMP*, though it has been deleted in the surface structure. NP1 is not the antecedent of NP2 because NP1 dominates but does not C-command NP2. In (7b), however, NP2 C-commands NP3, so NP2 is a candidate for the antecedent of NP3. This of course is true only when we do not assume that the antecedent is in *COMP*. (7d) shows that NP1 cannot be the antecedent of NP2 for the same reason as in (7a). The notion of ‘C-command’ provides us with an answer to the structural circularity problem. When we choose option (7d) ‘Nom-analysis’, is it possible to regard the *Nom** as the antecedent of NP2? Of course it is not. According to the categorial grammar, the *Nom** and NP2 have different types.⁵ If we assume that the empty category is not dominated by a term phrase (that is, NP), but by a common noun (that is, N), the relativization rule will violate the well-formedness condition.

(8) Well-formedness condition (B.H. Partee (1979))

Each syntactic rule operates on well-formed expressions of specified categories to produce a well-formed expression of a specified category.

Well-formedness condition (8) requires that the input as well as the output of a syntactic rule be a well-formed expression. Therefore, the input of the relativization rule must have a term phrase instead of a common noun in the position of the empty category.

Seemingly we come to a conclusion that (7b) is the best analysis if we assume the ‘C-command’ relation between the antecedent and the empty category in a relative clause. However, such a conclusion is not correct. The reason is that the head NP in the relative clause is different from the understood argument in some respects. Accordingly, the implicit argument is not understood to be the head NP or the head NP plus the relative clause. This will be clear in section 3.

3. A property of restrictive relative clauses: Scope-locality

In this section it will be made clear that the understood argument for the empty category in the relative clause is different from the head NP. Let us examine sentences (9) and (10).

(9) This is the man.

(10) This is the man I met yesterday.

There are two sources of the definite article: one is from the sentence level and the other from discourse or pragmatic level. Tentatively, the former will be called a structural 'the', and the latter a contextual 'the'. 'The' in sentence (9) is a contextual 'the', which is not structurally defined, while 'the' in sentence (10) is used thanks to the postmodifier which is the relative clause.⁶ The head NP is subject to restriction by the relative clause. The structural 'the' implies that the head noun is modified and restricted by the relative clause in sentence (10). Therefore, 'the man' in sentence (9) is not the same as 'the man' in sentence (10).

Now consider sentence (11).

(11) John hit the man Bill hit [e].

In sentence (11), the understood argument for the empty category is not the same as the head NP 'the man', nor the same as the head NP plus the relative clause 'the man Bill hit [e]'. Intuitively, sentence (11) is derived from (12), but not from (13).

(12) John hit a man [Bill hit a man]

(13) John hit the man [Bill hit the man]

In the process of combining two clauses in (12), the determiner 'a' of the main clause changes to the definite article 'the'. Or we can say that the determiner 'the' is combined with a common noun in the usual way as in Montague grammar. But anyway, note that the determiner 'the' of the head NP cannot influence the implicit argument in sentence (11). In other words, the empty category cannot be within the scope of the determiner 'the' of the head NP.

Let us return to see sentence (1). (Repeated here in (14) for convenience)

(14) (= 1) Sandy hit everyone Bill hit [c].

Sentence (14) does not imply (15), but rather (16).

(15) Sandy hit everyone [Bill hit everyone]

(16) Sandy hit everyone [Bill hit someone(s)]

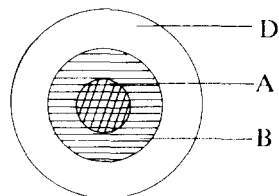
Sentence (14) means that Bill hit some of the members in the given full domain and all the members hit by Bill were also hit by Sandy. It does not imply that Bill hit all the members in the given full domain. As (16) shows, the object NP of the main clause is different from the object NP of the embedded clause in their domains and in their determiners. (By determiners I mean all the premodifiers including quantifiers.) In conclusion, the understood argument in sentence (14) is not taken for the head NP and also it is not within the scope of the universal quantifier 'every' of head NP. If this is correct, we do not need to worry about any circularity in relative clauses. In the meantime, if we derive any relative clause from (15), only the non-restrictive relative clause is possible, like sentence (17).⁷

(17) Bill hit everyone, who Sandy hit [c].

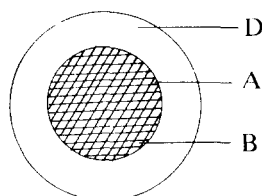
The understood argument in sentence (17) is 'everyone'.

From sentence (14), we can deduce relations (18a, b, c), but we can not infer (18d) as a possible relation.⁸

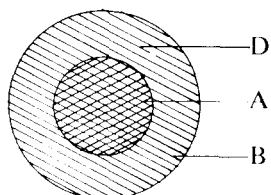
(18) a.



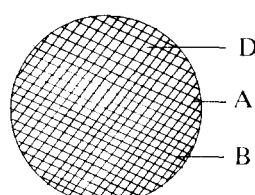
b.



c.



d.



(D: the full domain of persons, A: set of the members hit by Bill, and B: set of the members hit by Sandy)

In the relations of (18), the intersections of A and B are all the same. But, while (18a), (18b) and (18c) show that the set A is the proper subset of domain (D), (18d) shows that the set A is the same as domain (D). Our intuition is that the set A is not the same as the domain (D). Diagrams in (18) show that the relations in (19) are right.

- (19) a. $A \cap B = A$
 b. $A \subseteq B$
 c. $B \subseteq D$
 d. $A \subset D$

(19d) shows that the understood argument for the empty category in sentence (14) does not include the whole members of the domain. In other words, set A is a proper subset of the domain (D). We can generalize these relations as follows;

- (20) If the number of the members of domain (D) is n and the number of the members of set A is r , sentence (14) can be appropriately interpreted only when $n > r$. And the number of the cases that sentence (14) is interpretable is ${}^n C_1 + {}^n C_2 + \dots + {}^n C_{r-1} + {}^r C_r$.

What generalization (20) implies is that the number of the members of set A is not the same as that of the members of domain (D), and that the quantifier of the understood argument for the empty category in the relative clause cannot be the universal quantifier 'every'.

Let us examine some more examples.

- (21) a. Sandy hit all of whom Bill hit [e].
 b. Sandy hit some of whom Bill hit [e].
 c. Sandy hit no man Bill hit [e].

The understood arguments for the empty categories in sentences (21) are all to be *some* members of the full domain. No sentence in (21) implies that Bill hit all the members in the given full domain. Sentence (21a) implies that Bill hit some of the members and Sandy hit the whole members hit by Bill. Sentence (21b) implies that Bill hit some members in the given domain and Sandy hit some of the members hit by Bill. Sentence (21c) means that Bill hit some members but Sandy did not hit anyone of the members hit by Bill. Sentence (21c) does not mean at all that Bill did not hit any. That is, sentence (21c) presupposes that Bill hit someone(s). This presupposition-preserving reading is preferable particularly in *past*-tensed

sentences. It is of course possible to cancel this presupposition, but that is a pragmatic phenomenon.¹⁰ Here I am not concerned about it.

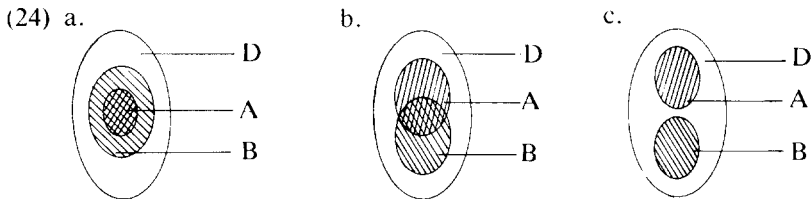
If our observation is true, sentences in (21) do not imply (22), but (23).

- (22)a. Sandy hit all [Bill hit all]
 b. Sandy hit some [Bill hit all]
 c. Sandy hit no man [Bill hit all]
 (or)
 Sandy hit no man [Bill hit no man]

- (23)a. Sandy hit all [Bill hit some]
 b. Sandy hit some [Bill hit some]
 c. Sandy hit no man [Bill hit some]

Note that in (23) we are ignoring the complement of 'A∩B', that is, the complement of set A with respect to set B in the case that the set consisting of the persons hit by Bill is A, and the set consisting of the persons hit by Sandy is B. Regardless of which the quantifier in the head NP is, the understood arguments in (21) are considered to take an existential quantifier, namely, *some*. This is one of the inherent properties of a restrictive relative clause.

Sentences in (21) have the relations like (24), respectively.¹¹



In (24a) the cross shaded area is the intersection of set A and set B (that is, $A \cap B$), which corresponds to 'all of whom Bill hit'. The cross shaded area in (24b) is the intersection of set A and set B (that is, $A \cap B$), which corresponds to 'some of whom Bill hit'. But there is no member in the intersection of set A and set B in (24c), which corresponds to 'no man Bill hit'.

Our observation is in accord with the remark of Gazdar (1982).

- (25) A parenthesized constituent in a phrase structure rule, if not chosen, is always to be interpreted as an existentially quantified variable of the appropriate type.

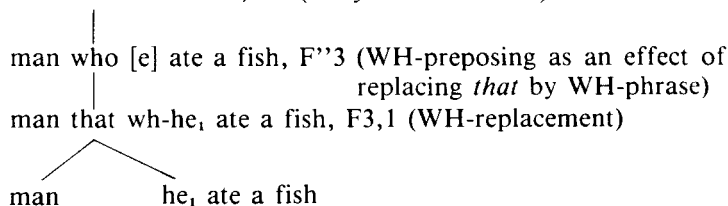
Here I conclude that the understood argument in the restrictive relative

clause takes an existential quantifier inherently.

4. Syntax

So far we have observed that the understood argument in the relative clause and the head NP are not the same in their domains and in their determiners. Most of the analysts have failed to notice this fact. Let us take R. Rodman (1976) as an example. He derives a relative clause as follows;

(26) Every man who ate a fish, F2 (*every*-concatenation)



In this syntactic process, one thing which is ignored by Rodman is what kind of quantifier the term phrase 'he₁' takes. As a result of this ignorance, the understood argument for the empty category lies within the scope of the quantifier 'every' after F2 rule (*every*-concatenation) is applied. We have observed that the understood argument should not be within the scope of 'every' of the head NP. If this property is ignored when a sentence with a relative clause is built up like (26), the compositionality principle must be violated because some of the meaning of relativizing NP 'he₁' will be lost.

Then, how can we connect the two NP's syntactically: the head NP and the relativizing NP? In other words, what is the device to apply the relativization rule to sentence (27)?

(27) Sandy hit the man [Bill hit a man]

On the other hand, how can we block the application of the rule to sentences (28)?

- (28) a. Sandy hit the man [Bill hit the man]
- b. Sandy hit the man [Bill hit men]
- c. Sandy hit the man [Bill hit a dog]

Barbara H. Partee (1979) suggests some revised measures. According to her suggestion, each syntactic rule of Montague grammar consists of some subfunctions and each subfunction in turn consists of some primitive opera-

tions. For example, the relativization rule has four primitive operations: GENDER, NUMBER, PRO and INDEX. Partee's primitive operations block the application of the relativization rule to (28b) and (28c). The two clauses in (28b) conflict with each other in NUMBER, and the two clauses in (28c) conflict with each other in GENDER. There is, however, no device to block the application to (28a) and to permit the application to (27).

I propose one condition on the environment of the relativization rule as follows;

- (29) The NP supposed to be substituted by *wh-he_n* should inherently take an existential quantifier.

To mark this condition to the input of the relativization rule, I introduce [-Def] feature.¹² The application of the rule $F_{3, n}$ (WH-replacement) is permitted only when a relativizing NP satisfies this condition as well as the other conditions (that is, Partee's four primitive operations). Condition (29) permits to derive sentence (30) from (27), but not from (28a).

- (30) Sandy hit the man Bill hit.

And also condition (29) predicts that the underlying form of (31) is (32), but not (33).

- (31) Everyone who owns a donkey beats it.

- (32) Everyone [someone owns a donkey] beats it.

- (33) Everyone [everyone owns a donkey] beats it

Condition (29) will be taken into consideration when a relative clause is translated into its logical form, for the quantifier not to influence the understood argument for the empty category.

Condition (29) elicits a theoretical problem—that such a condition on a single syntactic rule may damage some generalization. But one thing we should remember is that the evaluation of one theory should be carried out within the whole framework. Which is better, rough syntax but elaborated semantics or parallelism of syntax and semantics? I am ready to choose the latter. The latter implies that all the semantic informations should be manifested in syntax. (By the semantic informations I mean the literal meanings or the propositional contents as adopted at the sentence level.)

5. Semantics

Usually we take the head NP for the controller of the empty category in the relative clause. Strictly speaking, however, the determiner and the domain of the head NP are different from those of the understood argument for the empty category. Then, how can we connect the two arguments semantically?

Some attempts have been introduced in semantics. One of them is Sag's (1976) suggestion. He suggests the following translation in order to solve the circularity problem.

(34) $\forall y$ (Bill, λx (x hit y) \rightarrow Sandy, λw (w hit y))

Another one is Cormack's (1984). He translates sentence (14) into the following, insisting that the 'subject-in-wide-scope' reading is more natural.

(35) Sandy., λz ($\forall y$ (Bill., λx (x hit y) $\rightarrow z$, λw (w hit y)))

Expressions (34) and (35) are sure to have solved the circularity problem semantically. But the most serious defect is that the universal quantifier in (34) and (35) binds the understood argument as well as the head NP. In other words, expression (x hit y) as well as expression (w hit y) is within the scope of the universal quantifier $\forall y$. These translations do not reflect the characteristic property of the restrictive relative clause—the property that the relativizing NP takes an existential quantifier inherently. I want to reflect this property to the semantic translation. So, here I propose one of possible translations of sentence (1) (= (14)) into a logical form. Roughly, this is as follows;¹³

(36) [Sandy., λz [$\exists x$ (person' (x) \wedge Bill., λb (b hit x)) $\rightarrow \forall y$ (z , λs (s hit y))] $\leftrightarrow \exists x \forall y$ [$x = y$]]

Condition $\exists x \forall y$ [$x = y$] shows that this expression includes a relative clause and that the head NP and the understood argument in the relative clause are the same in reference and the same in number. The most significant fact from (36) is that the understood argument has an existential quantifier and that it is not within the scope of the universal quantifier of the head NP. Expression (36) may be elaborated or revised, but some attempt such as (36) should be made to reflect the inherent property of the relative clause.

6. Summary and conclusion

So far we have observed that the head NP and the understood argument in a relative clause are not the same. That is, the understood argument in a relative clause always takes an existential quantifier. The difference gives us an answer to the circularity problem. The implicit argument for the empty category in a relative clause is not understood to be the head NP plus the relative clause. Therefore, we do not have to worry about the circularity in a relative clause.

To reflect the characteristic property on the syntactic process, I have introduced a feature [-Def] to the input of the relativization rule. On the other hand, semantically I have proposed a new translation, for the understood argument not to be within the scope of the quantifier of the head NP because the understood argument has its independent existential quantifier. As a result, I can discard inconsistency of syntax and semantics, but win the parallelism between the two levels.

Notes

*This paper was presented at the 5th Korean-Japanese Joint Workshop on Formal Grammar Theory (on August 21, 1986 at Yonsei University Guest House at Wonju). I am greatly indebted to extensive advices and thorough critiques made by Professor Lee, Ik-Hwan.

1. It is arguable whether sentence (1) and (2) have implicit arguments. There are three options: (i) Chomskyan transformational grammar assumes that these sentences have implicit arguments both in syntax and in semantics; (ii) Montague grammar permits them only in semantics; (iii) Gazdar's GPSG and Bresnan's LFG rejects any implicit arguments both in syntax and in semantics. Here I will adopt an extended version of the transformational Montague grammar, which has the WH-phrase preposing rule. Henceforth I will call the empty categories 'understood' arguments instead of 'implicit' arguments.
2. This analysis of Brody's is quoted from Cormack (1984).
3. By the transformational Montague grammar I mean a version of Montague grammar which has a movement rule such as WH-phrase preposing rule.
4. I am not sure whether it is correct to assume \bar{S} -node instead of S-node in the structure (7b), (7c) and (7d), except (7a), especially in the case that WH-phrase is phonetically null at the surface structure.
5. Nom*, which is a common noun, is of the type $\langle e, t \rangle$, while NP2, which is a term phrase, is of the type $\langle s, \langle e, t \rangle, t \rangle$.

6. The same is the following example.

- (i) John hit *a man*.
- (ii) *John hit a man* Bill hit.

The 'a' of sentence (i) is the contextual 'a', while the 'a' of sentence (ii) is the structural 'a'. The latter has the specific reading, while the former is generic. The 'a' in the specific reading corresponds to 'one (man) of whom' in sentence (ii).

7. Sentence (17) can be paraphrased as follows;
- (i) Bill hit *everyone* and (then) Sandy hit *everyone*.
 - (ii) *Bill hit everyone* and (then) Sandy hit *him*.
- It, of course, is true only when each pair is coindexed.
8. Sentence (14) (= 1) may implicitly include the complement of Set A with respect of Set B as shown in (18a) and (18c), but does not show it explicitly. The complement of Set A with respect of Set B is not relevant to the interpretation of sentence (14).
9. The number of the cases that sentence (14) is interpretable is 30 when n is 5, in the case that n is more than r . That is, when $n = a, b, c, d$ and e , ${}_sC_1 + {}_sC_2 + {}_sC_3 + {}_sC_4 = 5 + 10 + 10 + 5 = 30$. This means that the case that the number of the members consisting of Domain D is the same as the number of the members consisting of Set A is excluded.
10. For more details, see Levinson (1983).
11. There was some discussion about the relations at Workshop. Mun, Kyong Hwan (Yonsei University) threw some doubt on them, but Lee, Hong-Bai (Sogang University) and Lee, Kee-Yong (Korea University) agreed with me.
12. Feature [-Def] implies that the term phrase supposed to be substituted by $wh\text{-}he_n$ should take an indefinite article or an existential quantifier.
13. At first I translated sentence (14) (= 1) as follows;
- $$[\text{Sandy*}, \lambda z [\text{E}x(\text{person}'(x) \wedge \text{Bill*}, \lambda b (b \text{ hit } x)) \rightarrow \forall y (z*, \lambda s (s \text{ hit } y))] \leftrightarrow [x = y]]$$
- This formulation was indicated not to be adequate by Akira Ishikawa (Sophia University, Japan). According to his indication this formulation is an open sentence because the variables x and y of the condition $[x = y]$ are not bound by any quantifier. Lee, IK-Hwan (Yonsei University) agreed with him and suggested (36) instead of my first formulation. Here I take Lee's suggestion.

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