

seeing the head is not likely to affect Ken anyhow, which in turn suggests that *Ken's* having the Affectee role is incompatible with the semantics of the *V* (*atama-o mir* 'look at the head').⁷

If the PR analysis were to account for the grammatical contrast between (42) and (45), it would have to stipulate that some class of verbs blocks NP-movement from the possessor position in the possession NP in an unmotivated way. In (47) the same verb does not block NP-movement of the direct object:

- (47) [NP Ken-no atama]-ga Aya-niyotte mi-rare-ta
 Ken-of head-NOM Aya-by see-PASS-PAST
 'Ken's head was seen by Aya'

The proposed DS in (43) is not a mere stipulative solution that is designed only to account for the Japanese possessor passive. Rather, it is one of the possible argument alignments at DS that the Universal Grammar allows. The way in which internal arguments are aligned as in (43) is shared by at least two constructions in other languages. First, let us look at the double accusative construction in Korean, exemplified in (48):

- (48) Mary-ka John-ul phal-ul pwutcap-ess-ta
 Mary-NOM John-ACC arm-ACC grasp-PAST-DEC
 'Mary grasped John by the arm'

In (48), the NP *John-ul* is understood to be the (inalienable) possessor of the object denoted by *phal-ul*. A noticeable point about this construction is that the possessor NP bears the same Case (Accusative Case) as the possession NP, instead of being marked Genitive, as in (49):

- (49) Mary-ka John-uy phal-ul pwutcap-ess-ta
 Mary-NOM John-of arm-ACC grasp-PAST-DEC
 'Mary grasped John's arm'

Cho (1992) proposes the DS in (50) for (48), where the possessor NP is an independent argument that is assigned the Affectee role by the verb, instead of taking sides with the PR analysis which might have it that the possessor NP is raised from the genitive position inside the possessor NP as in (51):⁸

(50) [IP Mary [VP [NP John] [v' [NP phal] pwutcap]]-ess-ta]

(51) a. DS: [IP Mary [VP [v' [NP [NP John] phal] pwutcap]]
-ess-ta]

b. SS: [IP Mary [VP [NP John]_i-ul [v' [NP t_i phal]-ul
pwutcap]]-ess-ta]

The pieces of evidence he presents to support his analysis include the following. First, he points out that the genitive position inside the possession NP can be filled with a Genitive-marked lexical pronoun:⁹

(52) a. Mary-ka John-ul tali-lui cha-ess-ta
Mary-NOM John-ACC leg-ACC kick-PAST-DEC
'Mary kicked John's leg'

b. ?Mary-ka John_i-ul [NP ku_i-uy tali]-lui cha-ess-ta
Mary-NOM John-ACC he-of leg-ACC kick-PAST-DEC
'Mary kicked John's leg' (Cho (1992))

Second, he cites the following example to show that the possessor NP is θ -assigned by the verb. Compare (53) with (50a):

(53) *Mary-ka John-ul tali-lui po-ess-ta
Mary-NOM John-ACC leg-ACC see-PAST-DEC
'Mary saw John's leg'

As with the example of Japanese possessor passive in (45), the Affectee role on *John* in (53) is not compatible with the semantics of *V' tali-lui po* 'see (his) leg', an activity that is unlikely to affect John.

Although I propose that the possessor passive in Japanese and the double accusative in Korean share the identical alignment of internal arguments at DS, Japanese and Korean are different in that Japanese lacks the syntactic device for the Affectee NP to appear at SS in its DS position, which Korean has, presumably because of the parametric difference in the Case-marking system in these languages. The following sentence, analogical to its Korean counterpart, is unacceptable:¹⁰

- (54) *Aya-ga Ken-o atama-o tatak-ta
 Aya-NOM Ken-ACC head-ACC pat-PAST
 'Aya patted Ken's head'

While the "Affectee" argument cannot survive in an active sentence, it can in a passive sentence. If the passive morpheme *rare* attaches to the verb, it absorbs the Agent role that would otherwise be assigned to an NP in the subject position. The demoted Agent is assigned to an NP in PP headed by the postposition *-ni / -niyotte / -kara*. The "Affectee" NP then moves to the subject position to be assigned Nominative Case. Notice that, as in Jaeggli (1986), Case-absorption and Agent demotion by the passive morpheme are independent processes in the grammar so that they do not have to take place, or be kept from taking place, simultaneously. I take the possessor passive in Japanese as a result of only Agent demotion taking place. If both of these processes are carried out by *rare*, the derivation yields a direct passive sentence. If neither of them takes place, the structure will yield an indirect passive sentence (cf. Washio (1990)). The passive morpheme *hi* in Korean can choose to carry out only Agent demotion, with Case absorption kept from taking place, yielding a sentence corresponding to a possessor passive in Japanese:

- (55) John-ka Mary-eykey phal-ul pwutcap-hi-ess-ta
 John-NOM Mary-by arm-ACC grasp-PASS-PAST-DEC
 'John had his arm grasped by Mary' (Cho (1992))

The proposed analysis of the possessor passive in Japanese also applies to the inalienable possession (henceforth, IPoss) construction in French (and in other Romance languages), as exemplified in (56):¹¹

- (56) a. Le médecin a examiné l'estomac aux enfants
 the doctor has examined the-stomach to-the children
 'The doctor examined the children's stomach'
 (Vergnaud and Zubizarreta (1992))
- b. On lui a coupé les cheveux
 they to-him have cut the hair
 'They cut his hair' (Kayne (1975))

In this construction, the "theme" possession NP is the direct object of the verb and the "affected" possessor NP is marked Dative. Kayne (1975) argues for the

independence of the direct object possession NP and the dative possessor NP at DS, showing that the IPoss construction is impossible with such "unaffected" verbs as *penser* 'think' and *rêver* 'dream'. If the grammatical "internal possessor" sentences in (58) were the derivational source from which the "external possessor" counterpart in (57) is derived, it would be unclear why (57a, b) are ungrammatical:

- (57) a. *Elle lui pensait aux oreilles.
 she to-him was-thinking to-the ears
 'She was thinking of his ears'
 b. *Jean lui rêvait des yeux
 Jean to-him was-dreaming of-the eyes
 'Jean was dreaming of her eyes'

- (58) a. Elle pensait à ses oreilles.
 she was-thinking to his ears
 'She was thinking of his ears'
 b. Jean rêvait de ses yeux
 Jean was-dreaming of her eyes
 'Jean was dreaming of her eyes'

This fact suggests, in our terms, that the affected possessor NP has a θ -marking relation with the V' consisting of the verb and its complement: the sentences in (57) are not grammatical since *penser aux oreilles* 'think of the ears' and *rêver des yeux* 'dream of the eyes' do not assign the Affectee role to the dative possessor argument.

Kayne (1975) also observes the grammatical contrast between (59a) and (59b) to point out an inadequacy of derivationally relating the internal possessor construction and the external possessor construction:

- (59) a. Tu as photographié leur bouches/*bouche.
 you have photographed their mouths/mouth
 'You photographed their mouths'
 b. Tu leur as photographié la bouche/*les bouches.
 you to-them have photographed the mouth/the mouths'
 'You photographed their mouths'

As we see from the sentence with an internal possessor in (59a), the possession noun must take its plural form if the possessor is plural. In contrast, the possession noun

in the external possessor sentence in (59b) can only be singular even though the dative possessor clitic *leur* is plural. If we were to take (59a) as the derivational source for (59b), it would remain unclear why there should be a difference in grammatical number in the two constructions.

These considerations naturally lead to positing the DS in (60b) for sentence (60a), where the NP *les enfants* 'the children' is arguably assigned the Affectee role compositionally from the verb *examiné*.¹²

- (60) a. La médecin a examiné l'estomac aux enfants. (= (56a))
 b. [_{IP} la médecin a [_{VP} [_{v'} examiné [_{NP} l'estomac]]
 [a+les enfants]]]

The above considerations on the Korean double accusative construction and the French IPoss construction do allow us to be convinced that the proposed analysis of the possessor passive construction in Japanese is not an ad hoc solution to the problems that we pointed out in Section 2. Rather, the proposed DS for the possessor passive is one of the possible configurations that the UG permits.

3.2 Possessor *pro*

I proposed in the preceding section that the surface subject of the possessor passive in Japanese is generated at DS as an argument of the verb that is assigned the Affectee role compositionally from the verb. Now one may ask what syntactic element, if any, occupies the genitive position in possession NPs. I rejected earlier the analysis wherein the genitive position is occupied by an NP trace. Then what is it that is there? I propose, approximately along the lines of Authier (1988), that the genitive position of possession NPs is occupied by a null pronominal NP, *pro*. Thus the structure of sentence (61a), for example, is represented as (61b):

- (61) a. Aya-ga Ken-niyotte kodomo-o home-rare-ta
 Aya-NOM Ken-by child-ACC praise-PASS-PAST
 'Aya had her child praised by Ken'
 b. [_{IP} Aya_i-ga [[Ken-niyotte [_{VP} t_i [_{NP} pro [_{N'} kodomo]]
 -o home-rare-ta]]]]

The null pronominal in the genitive position is assigned the Possessor role from the head noun and takes as its antecedent the trace of the surface subject "Affectee" NP.

Such body-part nouns as *atama* 'head', *kao* 'face', *ude* 'arm', and *asi* 'leg' and such kinship nouns as *kodomo* 'child', *hahaoya* 'mother', and *imooto* 'younger sister' obligatorily assign the Possessor role to an NP in the genitive position, since they necessarily imply the existence of their possessor. This means that the NPs headed by a body-part or a kinship noun necessarily contain *pro* in its genitive position, if they do not contain an overt possessor NP. By extension, other nouns such as *kuruma* 'car', *ronbun* 'academic paper', and *inu* 'dog' can optionally assign the Possessor role to the genitive position. Thus the bare NP *inu* 'dog' has either of the following two structures:

- (62) a. [NP *pro inu*]
 b. [NP *inu*]

The following examples tell us of the optionality of the assignment of the Possessor by such nouns as *inu*:

- (63) a. Ken-ga inu-o tureteki-ta
 Ken-NOM dog-ACC bring-PAST
 'Ken brought a dog (dogs)/his dog(s)'
 b. Ken-ga imooto-o tureteki-ta
 Ken-NOM younger sister-ACC bring-PAST
 'Ken brought his younger sister'

As we see from the English translations of the examples, the object NP *inu-o* in (63a) has both an indefinite reading ('a dog' or 'dogs') and a possession reading ('his (Ken's) dog/dogs'). The object NP in (63b) minimally contrasts with (63a) in that it lacks an indefinite reading ('a sister' or 'sisters'). This is because the NP headed by *inu* may or may not contain the possessor *pro*, whereas the NP headed by the kinship noun *imooto* must contain *pro*, which in turn takes the subject NP as its antecedent.

An immediate consequence of the above proposal is that it can account for the parallelism shown by a null pronominal on one hand and a body-part and a kinship NP on the other with respect to "anaphora." Hoji (1985) shows that *pro* is subject to the following condition on anaphora and thus exhibits a weak crossover effect:

- (64) A bound variable pronominal must be c-commanded by its antecedent QP.

- (13) John knows that Nancy₁ is kind.
 and
 Mary knows that Nancy₁ is kind.

To remedy this situation we, following A&O, adopt the concatenation technique, which allow us to concatenate agents when they share the common knowledge. The representation for the above sentence will be, roughly, as follows:

- (14) John and Mary know that Nancy_{<jm>} is kind.

where the series of letters *jm* within the angled bracket depicts the concatenated agents, and the number the depth of nesting. Intuitively, *Nancy* with concatenated agents _{<jm>} denotes *Nancy* from the common view of John and Mary: John and Mary share a belief about the same object denoted by *Nancy*. The formal definition of this common view is found in the next section. Now it should be clear how we can treat the above Hob-Nob problem. Since the only remaining problem is how to should guarantee that Hob and Nob have beliefs about the same entity (i.e. the denotation of *witch*), the following representation satisfies our requirements:

- (15) $\exists x_{<hn>}$ [Hob believes that *witch*($x_{<hn>}$) has killed
 Cob's cow and Nob believes that $x_{<hn>}$ has blighted
 Bob's mare]

where the variable $x_{<hn>}$ ranges over objects in the shared view of Hob and Nob. We omit indices on other expressions for simplicity.

As is well known, the topic of common knowledge is not restricted to the field of linguistics. We can easily find various situations where we utilize this type of knowledge, since we always need a basis of communicating with others. Though Jiang's theory presents, in some sense, solipsistic view: each agent has a different view about worlds, any serious approach to

knowledge has to provide an analysis of this aspect of knowledge. To get a feel of how we utilize common knowledge, imagine a perceptual situation (which provides a most typical example), in which Ken and John are seeing a teenager smoking. If Ken says to Tom, "That should not happen again around here", we understand that Ken is making an assertion based on the fact (i.e, referred to by the pragmatic anaphor) shared with Tom. More complicated example of this type can be found in Parikh(1990): when we dance, we are (at least pretend to be) sure that we share some knowledge with our partners, say, which direction to go, and which foot to step first. We next consider how our logic with concatenation technique relates to the general theories of common knowledge.

According to Barwise(1987) there has been three major approaches on this matter: the iterate approach, the fixpoint approach and the shared environment approach. We pick out, just for the sake of brevity, one of them: the iterate approach (it is equivalent to the fixpoint approach if we restrict ourselves to finite situation, which is the main argument of Barwise (1987)). Let σ is a fact, and suppose that we have two agents, p and q , who recognize the fact σ . If σ is a common knowledge, as a result of characteristics of common knowledge, we obtain the following infinite collection of additional facts: p knows σ , q knows σ , p knows q knows σ , q knows p knows σ , p knows q knows p knows σ (i.e, $K_p K_q K_p K_q \dots \sigma$), and so forth. This is equivalent to $K_{\langle pq \rangle} K_{\langle pq \rangle} K_{\langle pq \rangle} \dots \sigma$ in our notation of concatenation. Generally our logic of non-monotonic S5 with NAF does not accept such infinite iteration since the domain non-monotonically changes across worlds (i.e, the modal axiom 4 does not apply). This consequence seems to be quite close to our intuition since our information states varies and generally it is not plausible to assume that such infinite iteration can be performed through our constantly varying states. But such an extreme case can be possible if we imagine a humanoid that momentarily performs infinite inferences based on a domain obtained once for all (i.e, the logic will be S5 and therefore 4 holds). As far as real human beings are concerned, the logic of common knowledge should

not be so strong as S5, and therefore, an approach like ours should be made.

3. FORMAL SEMANTICS FOR INTENSIONAL CONTEXTS

We formalize the above discussion of common knowledge as an extension of the model provided by Jiang(1990). For this reason, we only discuss the point of modifications here. Jiang's model is adopted intact for the rest of the formalization. Before going into details some introduction to Jiang's model might be in order.

Jiang's model has the following Kripke-like model structure:

$$(16) M = \langle W, D, p, F \rangle$$

where W is a non-empty set of possible worlds, D_i a domain for each possible world, p_j the accessibility of an agent j , F the interpretation function. The key feature of his model is that the nesting of modal operator constitutes a chain of possible worlds each of which is linked by an agent's accessibility. Remember the example (4) reproduced in the following:

$$(17) B(\text{Simon}, B(\text{Tom}, L(\text{Venus}_2, \text{Mars}_1)))$$

The Venus is interpreted as Venus in Tom's mind from Simon's view: in a world accessible from Simon's belief world by Tom's accessibility which eventually comes from the actual world by Simon's accessibility. The indices simply indicates which possible world in the chain is responsible for the interpretation of a term/predicate.

Our model for common knowledge, while essentially adopt Jiang's strategy, brings partiality of agents into each world (i.e, domains). It must be plausible that an agent's knowledge does not cover the entire domain of a possible world, but only a portion of it. The definition of the domain comes to be as

follows:

1. D_i : a domain for each possible world, in particular D_0 is a domain for the actual world.
2. D_{ia} : a domain for an agent a of a possible world i .
3. $D_{ia} \subseteq D_i$, and $\cup\{D_{iE}\} = D_i$, where E denotes every agent.
4. Domain for concatenated agents
 $D_{i\langle ab \rangle} = D_{ia} \cap D_{ib}$, especially $D_{i\langle E \rangle} = \cap\{D_{iE}\}$

The clause 3 defines that an agent's domain constitutes a portion of an entire domain of a possible world. A new term E is introduced here to indicate that the entire domain of a possible worlds is defined by the sum of every member's domain. The clause 4 is the specification of a domain for concatenated agents. Since each of concatenated agents are considered to share entities in its domain, the domain of the new agent *<concatenated agents>* is safely considered to be the intersection of the domains of each member. A *<concatenated agents>* acts like an agent and, therefore, has its own accessibility. It provides a shared view point of its members.

NOTES

*I thank Seiki Akama, Shinsuke Homma and Mika Okuyama for valuable comments and discussion.

¹For another solution in the framework of Situation Semantics, see Barwise and Perry (1983).

²In Akama and Ohnishi(1990) we claimed that S5 is too strong for a system of knowledge, and proposed a detuned version of S5 (i.e., non-monotonic S5 with NAF) as a viable alternative, which serves as the basis of the analysis here.

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