ON PROCESSING EMPTY CATEGORIES IN ENGLISH AND JAPANESE

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1. INTRODUCTION

One of the more interesting questions of late has been the treatment of **empty categories** (EC) in natural language. **Empty categories** have been postulated in several mainstream grammatical theories, most notably the theory of Government and Binding, and have also been investigated in studies of sentence processing. The question which invariably interests linguists is the degree of relationship between formulations in grammatical theory and processing results in psycholinguistic experiments which employ those formulations as basic constructs. The interest has been one of long standing in matters of sentence comprehension, and more recently, this interest has been expanded to incorporate parsing strategies. There has, however, been a varied history of how theoretical linguistics has chosen to receive such information about processing constraints. By virtue of its self-claimed membership in the cognitive science fold, this interest has been now directed into determining what processing models of natural language should look like. In general, the linguist's expectation has been that the architecture of the processing mechanism, however specified, will not only be attuned to the grammar as such, but also reflect the structures posited therein. Fodor (1989:205) has most recently labelled this approach the Transparency Hypothesis, giving terminological substance to this Jungian set of disciplinary expectations.

A number of studies on the processing of empty categories in English have been conducted over the last several years which have largely suggested that the Transparency Hypothesis is correct insofar as English parsers are concerned. Since the representation of EC's is posited at an abstract level, such research claims to provide us with insights into the cognitive nature of the human processor itself, as well as the correlation between the grammar and the processor. We, of course, expect that the basic theoretical nature of EC's as a grammatical phenomenon would be generally the same across languages like English and Japanese. And indeed, this is an expectation which we have seen more easily fulfilled in deliberations on syntactic theory than the complementary demand from the processing side of modelling. That is, the quest for universality has also led us to expect that processing constraints on grammatical variables like EC's should turn out to be roughly the same across languages like English and Japanese. This paper, therefore, surveys this question of universality in respect to EC's and their psycholinguistic nature as measured by their degree of accessibility to syntactic antecedents. We should note that we have broadened the coverage to have our discussion of EC's include other elements which enter into relations of binding, such as pronouns and reflexives. We do so because these other elements also may call into play the psycholinguistic task of antecedent accessibility in sentence processing. There are linguistic reasons too, since some EC's, such as NP trace, *pro*, and PRO, are considered to share feature values with pronouns and reflexives.

2. COMPARISON OF ENGLISH EC'S WITH JAPANESE EC'S

If we assume that the mechanisms of syntactic processing are universal, in the same sense that we expect the mechanisms of syntactic theory to be universal, we expect that the processing of EC's in English and Japanese should be fundamentally the same. For example, we should predict that EC's which belong to the same syntactic categories should not differ widely in their antecedent accessibility in these two languages. English and Japanese are interesting prototypes for such a comparison, because they differ so radically in primary syntactic dimensions such as left-branching vs. right-branching sentence development, head-initial vs. head-final presentation of argument structure, and *pro*-drop. To test the scope of universalistic assumptions about processing of empty categories, this paper attempts to synthesize previous psycholinguistic work on this topic in the two languages. The focus of our inquiry is, therefore, threefold:

1.   to ascertain whether EC's exhibit accessibility to their antecedents in both languages;

2.   to ascertain the degree to which this processing strategy is the same or different in the two languages;

3.   and lastly, if there are differences, to ascertain what might cause such differences in the two languages, English and Japanese.

2.1   Empty Categories in English

Introduction: There have been a number of psycholinguistic studies on the processing of syntactic elements with long distance dependency in English, the majority of which are based on the theoretical framework of Government and Binding Theory (Chomsky, 1981). The main issues in much of this work reflect the attempt to determine whether EC's can be said to exist in some psychologically real sense, because EC's, like other anaphoric elements, access their antecedents in on-line sentence processing. A related issue has been to assess whether such EC's are the same or different in their degree of antecedent accessibility.

One common finding in recent work on the processing of EC's in English has been that these elements do indeed reactivate their antecedents. For example, in simple experimental tasks like end-of-sentence word verification, a probe word is processed faster when it is the antecedent of an EC than when it is not. This fact is explained by postulating that a probe word which is in such an antecedent position is processed twice; it is processed once at the antecedent location and then once again at its EC position. However, it has also been reported that EC's, as well as other anaphoric elements, exhibit different degrees of accessibility to their antecedents. The discussion which follows examines this differential in accessibility for such elements; the subsections in the discussion follow the same order as the formulaic summary of differences presented immediately below in our proposed hierarchy of accessibility (adapted from Nicol and Swinney, 1989).

Wh-traces > Pronouns/Reflexives > NP-traces > PRO

Wh-traces: Previous studies unanimously demonstrate that the EC type which shows the strongest accessibility to its antecedent is the *wh-trace*, and right across a variety of experimental techniques ranging from cross-modal priming, naming (Swinney et al., 1988), and even rhyme priming (Tanenhaus, Carlson and Seidenberg, 1985). Nicol (1988) argues that the reason why *wh*-traces

are so strong is because of their *expectability* quotient. This expectability arises because a *wh*-phrase stands out by being in a pre-clause, non-argument position; because the *wh*-phrase is well ahead of its trace, the processor has time to prepare for the encountering of this trace. Unlike other types of traces which lack such expectability, *wh*-traces are extremely robust in accessing their antecedents. Not surprisingly, theoreticians like Fodor (1990:196-197) rightly note that this "expectability" is a serious problem for extracting pure linguistic effects from experiments. The scope of *wh*-traces has been suggested by Nicol and Swinney (1989) as encompassing the immediate reactivation of all those antecedents which are structurally plausible antecedents, and in a way that is immune to semantic interference. That is, it has been demonstrated that even semantically incongruent elements are reactivated if they have appeared at structurally appropriate syntactic positions (Nicol and Osterhout, 1988).

Pronouns and Reflexives: Details aside, both pronouns and reflexives in English access their antecedents. In the case of reflexives, accessibility is observed only in regard to structurally plausible antecedents (Nicol, 1988). As for pronouns, however, it is not clear whether reactivation involves all preceding NP's (except for local NP's) which are structurally relevant (see Nicol and Swinney, 1989:14).

NP-traces: Our hierarchy places the NP-trace after pronouns and reflexives because the experimental conclusions are equivocal in respect to the processing of NP-traces. Two conflicting views have been presented in respect to accessibility for NP-traces (see Nicol and Swinney, 1989). For example, Bever and McElree (1988) examined NP-traces in passives by using an end-of-sentence word-verification task. Passives were paired with non-passives, as follows:

1.   *The astute lawyer who faced the female judge was suspected [EC] constantly*

2.   *The astute lawyer who faced the female judge was suspicious constantly*

Their experimental results indicated that probe words, like *astute* in the above sentences, were processed faster in passives than in non-passives. This processing difference was explained by claiming that probe words in passives were recalled faster because they were processed twice, once at the subject position and then once more at the [EC] trace position. Using the same experimental task, but examining both verbal and adjectival passives, MacDonald (1989) has reduplicated these findings. Priming effects were found for verbal passives, ostensibly because they contain an NP-trace; but they were not found for adjectival passives, ostensibly because they do not contain an NP-trace. In contrast, however, Osterhout and Nicol (1988) employed an on-line cross-modal task which measured reactivation effects during the processing of a sentence rather than after the sentence was completed (see Nicol and Swinney, 1989:11). Osterhout and Nicol found no significant priming effect in the actual trace position in passives, though there was an insignificant priming trend 1000 msec. downstream from the trace position. Our hierarchical summary attempts to balance these conflicting results, noting that the accessibility quotient for NP-traces is not as clear as that for pronouns, reflexives, and *wh*-traces.

PRO: Previous work uniformly reports that PRO is the weakest type of EC in antecedent-reactivation. It is generally held that EC's created by movement (e.g., *wh*-movement, passives, or NP-raising) are stronger in reactivation than those involving no movement (e.g., PRO). Bever and McElree (1988) attribute this weakness to the semantic nature of PRO, noting that the properties of PRO are largely determined by semantic factors derived from the main clause verb. Other EC

types are characterized by strictly syntactically-motivated binding. Such syntactico-semantic differences are thus suggested as the reason for accessibility differences between PRO and the other anaphoric elements.

Summary of English Results: In sum, even though English EC's exhibit accessibility to their antecedents, they do differ in their degree of accessibility. *Wh-traces* are reported as showing the strongest features of accessibility, perhaps largely due to the factor of expectability; at the opposite end of the accessibility continuum, PRO is the weakest, possibly due to its semantic nature.

2.2 Empty Categories in Japanese

Introduction: The record of psycholinguistic studies of EC's in Japanese is somewhat sparser, and there are typological differences which do not allow us to compare English EC's and Japanese EC's in a straightforward manner. For instance, *wh*-traces do not apppear in Japanese because the language lacks *wh*-movement (although Watanabe (1991) claims otherwise). But Japanese exhibits EC's which are derived from scrambling, a type of movement which is lacking in English. If we extrapolate from what literature there is (admittedly relying largely on Nakayama's work (1990a, b, 1991a, b)), the accessibility hierarchy for Japanese EC's looks something like the one below.

Empty pronouns > NP-traces > Overt pronouns > PRO > Reflexive jibun

Although Nakayama (1990a) claims that English EC's and Japanese EC's are basically the same in respect to antecedent accessibility, this does not square with the way in which the above hierarchy compares to the English hierarchy cited above. Our reading of the evidence suggests that EC's in these two languages differ in respect to antecedent accessibility.

Empty Pronouns: An experiment reported by Nakayama (1990a) found that empty pronouns exhibited short reaction times in a word-verification task performed at the end of test sentences. Empty Pronouns (*pro*) exhibited faster reaction times than even overt pronouns (*kare* 'he' and *kanojo* 'she'), *PRO*, and the Japanese overt reflexive (*jibun* 'oneself'). For examples of such sentences, consider sentences (1) through (4) below.

1. Empty Pronoun (*pro*):
   Toshokan de benkyooshiteita gakusei-ga tomodachi-ni [pro] shukudai-o shiteoita to tsugeta.
   'The student who was studying at the library informed (his) friend that *pro* did homework (for him).'

2. Overt Pronoun (*kanojo*):
   Machi-o aruiteita obasan-ga keisatsu-ni [kanojo]-ga doroboo-o mita to denwashita. 'The woman who was walking on the street telephoned the police that *she* saw the thief.'

3. *PRO*:
   Paatei-no yooi-o shiteiru dansei-ga John-ni [PRO] Mary-o shootaisuru to yakusokushita.
   'The man who was preparing for the party promised John *PRO* to invite Mary.'

4. Overt reflexive (*jibun* 'oneself'):

104

Yakusoku-o yabutta otto-ga okusan-ni jibun-ga tashikani warukatta to ayamatta. 'The husband who broke the promise apologized (to his wife) that *self* was certainly wrong.'

Nakayama (1990a) accounts for this finding by arguing that Japanese *pro* and the English pronouns ultimately belong to the same category. But this suggestion does not account for the finding that explicit pronouns in Japanese are about as weak in their activation strength as referential R-expressions. It is obvious that English does not have *pro*, and that a one-to-one comparison is impossible, but the suggestion that Japanese *pro* is equivalent to the English pronominal category is simply a categorizational sleight-of-hand to attempt to account for the data. The psycholinguistic fact is simply that Japanese *pro* shows strong, possibly the strongest, antecedent accessibility; this activational strength cannot be accounted for just by equating *pro* to English pronouns.

NP-traces: Psycholinguistic work with NP-traces in Japanese has examined NP-traces in both unaccusatives and direct passives. Nakayama (1990a; 1991a) has demonstrated that NP-traces in unaccusatives are very strong reactivators, but his work has not provided any reason why NP-traces in unaccusatives are so strong. For an example of the Japanese unaccusative, compare (1) and (2) below.

1.   Unergative:
        John-ga (inukaki-de) oyoida. 'John swam (by dog paddling).'

2.   Unaccusative:
        John-ga (rokuji-ni) [trace] tsuita. 'John arrived (at six o'clock).'

Unfortunately, there is no data concerning English unaccusatives, making it impossible at this point to compare unaccusative NP-traces in English and Japanese.

NP-traces which are created by passivization in Japanese are somewhat mixed in their reactivation effects. For example, in replicating Bever and McElree's (1988) work, Nakayama (1990a) found that in Japanese passives traces show strong reactivation of antecedents in direct passives only when they contain a by-phrase which expresses the agent. Such strong reaccessibility is not manifested, however, when the passive does not contain such a by-phrase which makes the agent explicit. For examples, of these two direct passives in Japanese, compare sentences (1) and (2) below.

1.   Direct Passive with Overt Agent:
        Jikken-ni seikooshita kenkyuusei-ga kyooju-ni [trace] homerareta. 'The student who succeeded in the experiment was praised by his professor.'

2.   Direct Passive without Overt Agent:
        Kane-o tsukaikonda kachoo-ga tetteitekini [trace] hinansareta. 'The section head who used the company money was criticized thoroughly.'

This unexpected result is explained by claiming that the processing delay is caused by the processor's pragmatic expectation of encountering an agent for the passivized action; because the processor cannot find such an agent, a certain amount of processual wandering is supposedly manifested as a time delay in processing. Whatever the real explanation, NP-traces in Japanese pas-

sives cannot be uniquely classified as strong reactivators. Thus, in both English and Japanese, NP-traces in passives are not always strong reactivators; in Japanese direct passives, the accessibility of antecedents is further attenuated by pragmatic factors like the processor's search for adjunct information on who the agent is. Since there is no experimental comparison of *pro* with NP-traces in respect to antecedent accessibility, there is no clear evidence from which to conclude which is stronger (see Nakayama (1990a)). However, noting the non-homogeneity of NP-traces in respect to reactivation, we have ranked *pro* above NP-traces in the accessibility hierarchy.

Overt pronouns: There are clear differences between the two languages when it comes to overt pronouns. Although they are not as robust as *wh*-traces, English pronouns show relatively strong reactivation capabilities for structurally plausible antecedents, as measured by word-verification times. Overt pronouns in Japanese, however, are extremely weak in accessing their antecedents. In fact, they are so weak that Nakayama (1990a) was prompted to re-classify them as R-expressions. Nakayama (1990b) has further demonstrated that overt pronouns differ from NP-traces in Japanese. NP-traces, unlike pronouns, can access their entire phrasal antecedent; but this is not true for pronouns in Japanese, suggesting that the scope of their antecedent accessiblity is fairly limited.

1.   NP-trace Accessing Entire Antecedent Phrase:
       [Supiichi-o yomu tomodachi-ga] yatto [trace] kita 'The friend who is going to read the speech finally came.' (unaccusative)

2.   Overt Pronoun Partially Accessing Antecedent Phrase:
       [Machi-o aruiteita obasan-ga] keisatsu-ni [kanojo]-ga doroboo-o mita to denwashita. 'The woman who was walking on the street telephoned the police that *she* saw the thief.'

We will refrain from speculating on why Japanese pronouns are so weak, but it is obvious that overt pronouns in these two languages are very different in respect to antecedent accessiblity.

Reflexive jibun: This same observation applies to the Japanese reflexive (*jibun* 'oneself'). *Jibun* was weakest in its reactivation capacity in comparsion to the other EC's and anaphoric elements. So much so that Nakayama (1990a) found no difference between *jibun* and the non-anaphoric expressions he used as controls.

1.   Overt reflexive (*jibun* 'oneself'):
       Yakusoku-o yabutta otto-ga okusan-ni [jibun]-ga tashikani warukatta to ayamatta. 'The husband who broke the promise apologized to his wife that [self] was certainly wrong.'

2.   Control (non-anaphoric):
       Terebi-bakari miteiru kodomo-ga okaasan-ni [kono bangumi]-wa benkyoo-ni narune to tsubuyaita. 'The child who watches TV murmured to his mother that [this TV programme] was educational.'

This weak capacity does not correspond to the English reflexive, suggesting that Japanese and English also differ considerably in this aspect of the accessibility hierarchy.

PRO: Japanese PRO is a weak reactivator, as it is in English, and our hierarchy places it between overt pronouns and *jibun*. This relative weakness has been attributed to its semantic nature (see

Bever and McElree, 1988, as well as Nakayama, 1990a), in that it lacks purely syntactic binding constraints. That is, the choice of antecedent for PRO is determined by semantic rather than syntactic factors. Although English and Japanese PRO may be roughly the same in antecedent accessibility, their position of relative weakness on the hierarchy, when compared to other anaphoric elements, lacks a satisfactory explanation.

1.   English PRO:
The astute lawyer who faced the female judge strongly hoped [PRO] to argue during the trail.

2.   Non-anaphoric Construction:
The astute lawyer who faced the female judge hated the long speech during the trial.

3.   Japanese PRO:
Paatei-no yooi-o shiteiru dansei-ga John-ni [PRO] Mary-o shootaisuru to yakusokushita.
'The man who was preparing for the party promised John [PRO] to invite Mary.'

4.   Non-anaphoric Construction:
Paatei-no yooi-o shiteiru dansei-ga John-ni Mary-wa sutekida-to itta 'The man who was preparing for the party said to John that Mary was beautiful.'

3. CONCLUSIONS

In summary, we can offer the following conclusions. Recall that our accessibility hierarchies for English and Japanese were postulated as follows:

ENGLISH: **Wh-traces > Pronouns/Reflexives > NP-traces > PRO**

JAPANESE: **Empty pronouns > NP-traces > Overt pronouns > PRO > Reflexive jibun**

First, while English *wh*-traces offer the strongest evidence in respect to antecedent accessibility, no comparisons are possible because Japanese lacks *wh*-movement. Secondly, although Japanese *pro* and unaccusative NP-traces exhibit strong antecedent accessibility, their exact standing relative to one another in the hierarchy is as yet unclear. Comparisons with English are impossible because English lacks *pro*, and English data is unavailable for unaccusative NP-traces. Third, NP-traces in English and Japanese passives share a somewhat similar position in respect to their equivocal position on the hierarchy; NP-traces are neither as strong as *wh*-traces and pronouns in English nor are NP-traces as strong as *pro* in Japanese. Moreover, in Japanese their accessibility quotient may be attenuated by other than purely syntactic factors. Fourth, in both English and Japanese, PRO is a weak reactivator. Semantic explanations have been offered (Bever and McElree, 1988, and Nakayama, 1990a) to account for PRO's weak showing, but these semantic explanations cannot be regarded as universally satisfying. For one thing, Japanese *jibun*, a syntactic bindee, shows weaker reaccessibility than PRO. Fifth, there are clear differences between these two languages in the area of overt pronouns and reflexives. In English, both are relatively strong reactivators, but in Japanese they are weak enough to prompt some to re-classify them as R-expressions.

These observations lead to the conclusion that processing models will have to account for differential psycholinguistic behavior with empty categories and anaphoric elements. Very simply, the nature of the processing task may differ across languages like Japanese and English. Whatever the abstract treatment of empty categories and anaphoric elements in the grammatical scheme of things, their language-specific processing status appears to be a somewhat internal matter, and theoretical claims about uniformity in strategies to deal with these common elements at the syntax-discourse boundary seem to have been overstated, given our present state of knowledge. We have no doubt that there are universal processing strategies, but have our doubts that they will exactly mirror the constructs of any one current syntactic theory. The final explanations will ultimately be based upon processing strategies which are more psychological in nature, and may not use the structural elements posited by grammatical models. In short, if empty categories and anaphoric elements in language are any indication, the fit between grammatical models of language and processing models of language is as yet a very loose one. And if the fit between processing results in two languages like Japanese and English is not atypical, we have much to do in order to construct universally valid explanations of what does go on in processing.

REFERENCES

Bever, T. and B. McElree. (1988). Empty Categories Access Their Antecedents during Comprehension. *Linguistic Inquiry* 19, 35-43.

Chomsky, N. (1981). Lectures on Government and Binding. Dordrecht: Foris.

Fodor, J.D. (1989). Empty Categories in Sentence Processing. *Language and Cognitive Processes,* 4, 155-209.

MacDonald, M. (1989). Priming Effects from Gaps to Antecedents. *Language and Cognitive Processes*, 4, 35-56.

McElree B. and T. Bever. (1989). The Psychological Reality of Linguistically Defined Gaps. *Journal of Psycholinguistic Reserch*, 18, 21-35.

Nakayama, M. (1990a). Priming and Anaphoric Expressions in Japanese. Unpublished Ms., The Ohio State University, Columbus, Ohio.

Nakayama, M. (1990b). Accessiblity to the Antecedents in Japanese Sentence Comprehension. Unpublished Ms., The Ohio State University, Columbus, Ohio.

Nakayama, M. (1991a). Japanese Motion Verbs and Probe Recognition. Unpublished Ms., The Ohio State University, Columbus, Ohio.

Nakayama, M. (1991b). Scrambling and Probe Recognition. Unpublished Ms., The Ohio State University, Columbus, Ohio.

Nicol, J. (1988). *Coreference Processing During Sentence Comprehension.* Unpublished Ph.D. dissertation, M.I.T.

Nicol J. and D. Swinney. (1989). The Role of Structure in Coreference Assignment During Sentence Comprehension. *Journal of Psycholinguistic Research*, 18, 5-19.

Swinney, D., M. Ford, U. Frauenfelder, and J. Bresnan. (1985). On the Temporal Course of Gap-Filling and Antecedent Assignment During Sentence Comprehension. In B. Grosz, R. Kaplan, M. Macken, and I. Sag (Eds.) *Language Structure and Processing*, Stanford, CA: CSLI.

Tanenhaus, M., G. Carlson, and M. Seidenberg. (1985). Do Listeners Compute Linguistic Representations? In A. Zwicky, L. Kartunnen, and D. Dowty (Eds.) *Natural Language Parsing: Psycholinguistic, Theoretical, and Computational Perspectives*. London: Cambridge University Press.

Osterhout L. and J. Nicol. (1988). The Time-Course of Antecedent Activation Following Empty Subjects. Unpublished Ms.

Watanabe, A. (1991). Wh-In-Situ, Subjacency, and Chain Formation. Unpublished Ms., M.I.T.

110