

36 Processing empty categories in Japanese

Tsutomu Sakamoto

Introduction

The issue to be discussed in this chapter is whether a human parser assigns interpretations to phonetically null elements in sentences, i.e. empty categories (ECs). Since ECs are abstract constructs postulated by theoretical requirements, the processing of ECs is necessarily concerned with the validity of a linguistic theory with and without ECs (Featherston, 2001). Furthermore, the syntactic characteristics of ECs are not homogeneous. For instance, Chomsky (1982) discriminates four types of ECs: PRO, *pro*, anaphor (NP-trace), and variable (WH-trace). PRO appears in subject position of infinitival clauses (and gerunds) while *pro*, a phonologically null pronoun, appears in tensed clauses and is free or locally bound by an argument antecedent that has an independent Theta-role. An anaphor or NP trace is locally bound by an argument antecedent that lacks an independent Theta-role (e.g. traces left behind by the surface subjects in passives). A variable or WH-trace is in an argument position and locally bound by an element in a nonargument position. Here, we focus on Japanese counterparts of PRO and WH-trace, as illustrated in (1) and (2).

- (1) John₁-ga Mary₂-ni [PRO₁ Tokyo iki]-o yakusokusita.
-NOM -DAT going-ACC promised.
“John₁ promised Mary [PRO₁ to go to Tokyo].”
- (2) Dare₁-o John-ga trace₁ nagutta no?
who-ACC -NOM hit Q
“Who₁ did John hit trace₁?”

Although the criterion for discrimination of these ECs may not be universal (Fiengo & Haruna, 1987; Whitman, 1985), and it is possible to assume that ECs are homogeneous to the parser (see Miyamoto, this volume, chapter 34), we assume that ECs are distinguished as stated above. Since the characteristics of these ECs are different, it is interesting and worthwhile to investigate them in various constructions from both the theoretical and experimental viewpoints.

Processing of null subjects

Jackendoff (1972) assumes that a verb determines a control relation between PRO and its argument, which is termed as *obligatory control*. Subject control verbs assign control to their subjects; object control verbs assign control to their objects. Nonobligatory control (Williams, 1980) describes the situation in which the verb does not uniquely specify an argument to be the controller of PRO (e.g. “It is good for one’s health [PRO] to get up early in the morning.”). This will not be discussed here.

Frazier, Clifton, and Randall (1983) tested English control structures, to determine strategies for identifying the antecedent of PRO:

- (3) a. Subject-control (Recent-filler) sentence
Everyone liked the woman who₁ *the little child*₂ started [PRO₂ to sing those stupid French songs for *trace*₁ last Christmas].
- b. Object-control (Distant-filler) sentence
Everyone liked *the woman who*₁ the little child forced *trace*₁ [PRO₁ to sing those stupid French songs last Christmas].

In (3a) above, a subject control verb *started* assigns its subject *the little child* to be the controller of PRO. This subject is closer (by number of intervening words) to PRO than *the woman* is. Hence, the filler is also a *recent filler*. In (3b) above, the verb *forced* assigns its object *the woman* to be the controller of PRO. This is the *distant filler*. Frazier et al. hypothesized that if recency was a factor in identifying the proper antecedent, then sentences with recent fillers should produce faster reaction times than sentences with distant fillers.

Experimental sentences were presented one word at a time on a CRT screen. At the end of each sentence, the participants indicated whether they understood the sentence (“got-it”) or had to reread it (“missed it”). Distant filler sentences required more processing time and produced more errors than the recent filler sentences. Frazier et al. explained these findings with the Most Recent Filler (MRF) strategy: “During language comprehension a detected gap is initially and quickly taken to be co-indexed with the most recent potential filler.” They imply that the MRF strategy applies only when the parser does not have reliable information about the correct filler for a gap. This initial choice is later overridden, if necessary, by lexical information supplied by the verb. It is this error-correcting procedure that causes the longer processing time in the distant filler sentences. Furthermore, Frazier et al. imply that the parser does not recognize a gap (*trace*) as a possible filler for another gap (PRO). This is termed the Lexical Filler Only hypothesis in Sakamoto (1996). This account has two important consequences: first, lexical control information is not immediately available, and second, the parser relies on a heuristic strategy based on recency.

Sakamoto (1996) reports the results of a series of experiments to test the MRF hypothesis in Japanese (see also Sakamoto 1995, 2002; Sakamoto & Walenski, 1998), which offers two advantages over English. First, verbal control information is delayed, since Japanese is a verb-final language. Second, Japanese allows scrambling of arguments, so that either argument of a control verb may be put in a recent filler or distant filler position.

(4)

a. Subject-control + canonical order

Kooiti₁-ga kaisya-de Tamae₂-ni [PRO₁ Tokyo iki]-o wazato *moosideta*.
-NOM company-at -DAT going-ACC purposely offered.

Lit. "Kooiti, at the company, purposely offered Tamae that *he* would go to Tokyo."

b. Object-control + canonical order

Kooiti₁-ga kaisya-de Tamae₂-ni [PRO₂ Tokyo iki]-o wazato *saisokusita*.
-NOM company-at -DAT going-ACC purposely urged.

Lit. "Kooiti, at the company, purposely urged Tamae that *she* should go to Tokyo."

Participants listened to each sentence and responded by naming the person who was going to Tokyo. If the human parser is insensitive to the presence of PRO, the ratio of correct responses should be 50 percent and the reaction times for the two sentence types should be similar.

The percentage of correct answers was fairly high for both types (88.9% and 90.2%) with no significant difference. The mean reaction time for object control sentences (with recent fillers) was significantly faster than for subject control sentences. Thus, the results support the hypothesis that the MRF strategy applies to Japanese control structures. However, another possible explanation is that the parser prefers to assign control to an object initially, perhaps because of the object's grammatical function. The second experiment was designed to compare these two hypotheses.

"Scrambling" of NPs should directly affect the application of the recency strategy, because the surface positions of the two antecedents would be reversed, as shown in (5a–b).

(5) a. Subject-control + scrambled order

Tamae₂-ni kaisya-de Kooiti₁-ga *trace*₂ [PRO₁ Tokyo iki]-o
-DAT company-at -NOM going-ACC

wazato *moosideta*.
purposely offered.

Lit. "To Tamae, at the company, Kooiti purposely offered that *he* would go to Tokyo."

b. Object-control + scrambled order

Tamae₂-ni kaisya-de Kooiti₁-ga *trace*₂ [PRO₂ Tokyo iki]-o
-DAT company-at -NOM going-ACC

wazato *saisokusita*.

purposely urged.

Lit. “To Tamae, at the company, Kooiti purposely urged that *she* should go to Tokyo.”

The results showed that the reaction time for object control sentences was still significantly faster than for subject control sentences. Thus, the object was preferred as controller even when it was the distant lexical filler.

By contrast, Oda et al. (1997) and Ninose et al. (1998), using a “recognition task” with a yes/no decision, demonstrated a “subject preference” despite different word orders. One thing is clear: scrambling does not affect the preference of antecedent. See Sakamoto (2002) for more detail.¹

Probe recognition and scrambling

Bever and McElree (1988) conducted experiments to investigate various kinds of empty categories in English. They used a *probe recognition priming technique* in which a sentence is presented one phrase at a time on a CRT screen each time a participant pushes a button. At the end of the sentence, a *probe word* appears on the screen. The subject must decide whether the probe word was contained in the sentence just presented. Reaction times demonstrated that the probe word was reactivated due to the existence of ECs.

Employing this technique, Nakayama (1995) investigated whether scrambling in Japanese leaves a trace, as is assumed in the model by Saito (1985; cf. Nemoto, 1999).

(6) a. Canonical order

Kyoo [mondai-o dasita sensei]-ga [syukudai-o
today problem-ACC assigned teacher-NOM homework-ACC

wasureta seito]-o Sikatta.

forgot student-ACC scolded

“Today, the teacher who assigned the problem scolded the student who forgot the homework.”

¹ We have discussed some previous studies concerning filler-gap dependencies, in which the filler precedes the gap. In some relative clauses, however, the gap precedes the filler in the linear order of elements. That is, the relative head (=filler) can be extracted from the relative clause leaving a trace behind it. See Hirose (this volume, chapter 35) for discussion of this issue.

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b. Scrambled order

Kyoo [*syukudai*-o wasureta seito]_i-o [mondai-o dasita sensei]-ga
trace_i sikatta

If scrambling leaves a trace, the probe word *syukudai* should be accessed a second time at the trace's location. Thus, probe recognition time for the scrambled sentence should be faster than for the canonical sentence. The results showed the opposite: mean reaction time for scrambled sentences was slower. However, it was also the case that the probe word of the scrambled sentence was always more distant from the end of the sentence than the probe word of the canonical sentence. In other words, the factors of "scrambling" and "distance" cannot be examined separately (see Gunji & Sakamoto, 1999).

In order to resolve this problem, Nakayama (1995) conducted a second experiment, using a 2x2 design to eliminate the effect of probe position. The sentences were canonical or scrambled, and the probe word was distant from or close to the end of the sentence. Even in this experiment, the sentences with recent probes exhibited faster reaction times than those with distant probes. Although it was predicted that scrambling would facilitate the reactivation of the probe word owing to the existence of trace, the results showed that this prediction was not correct. Nakayama (1995) indicated that scrambling was an optional operation in the sense that it did not affect the grammaticality of the given sentences in the experiment. Thus, the effect of scrambling could have been overwhelmed by the effect of recency. To resolve the problem of Nakayama's experiment 1 in a different way, Miyamoto and Takahashi (2002a) designed experimental sentences as follows:

(7)

a. Canonical order

[Gakkoo-de *mondai*-o dashita kooshi]-ga [mukuchina gakusei]-o mita.
school-loc question-ACC asked lecturer-NOM quiet student-ACC saw
"The lecturer who asked the question at school saw the quiet student."

b. Scrambled order

[Gakkoo-de *mondai*-o dashita kooshi]_i-o [mukuchina gakusei]-ga [gap]_i mita.
"The quiet student saw the lecturer who asked the question at school."

Here, the probe word *mondai* "question" is located at the same position in both (7a) and (7b). Miyamoto and Takahashi (2002a) found a significant effect of scrambling (see Miyamoto, this volume, chapter 34). Thus, they claim that the trace of moved element reactivated the probe word at the gap position in the scrambled sentence. However, (7b) is not the scrambled version of (7a): they are two different sentences.

Nakano et al. (2002) considered that the cost of scrambling might be a function of the distance between a trace and its antecedent. They investigated “long-distance scrambling” as follows:

- (8) Suruto, remon_i-o, [_{CP/IP} futari-me-no hito-ga shikaisha-ni,
And then lemon-ACC the second person-NOM M. C.-DAT
[sono kodomo-ga onna-no hito-ni *trace_i* nedatte-iru to] kotae-ta]
that child-NOM female person-DAT asking COMP answered]
Lit. “And then, a lemon, the second person answered to the Master
of Ceremonies that that child was asking the woman for.”

Participants were instructed to listen to the tape-recorded sentences and to make lexical decisions on visually presented target words. In this *cross-modal lexical priming task*, the target words were the moved NP (*remon* “lemon”) and a semantically unrelated word such as *sonata* “sonata”. These target words were presented at the putative trace position and 500 ms earlier than that point. Reaction times to the identical word (i.e. probe word) were significantly faster than to the unrelated word. This was observed only in the trace position and not in the pre-trace position. Thus, reactivation of the probe word occurred at the trace position. However, this effect of trace reactivation was observed only in the high reading-span group of participants whose working memory capacity is greater than that of the low reading-span group (cf. Osaka, 1998).

To summarize, Nakayama (1995) did not find a reactivation effect of the trace because there was no difference between the probe recognition times for canonical and scrambled sentences. Miyamoto and Takahashi (2002a) reported faster reaction times owing to the existence of a trace. Nakano et al. (2002) also observed the reactivation effect of trace in long-distance scrambling sentences, but only in a high reading span group. These studies adopted the idea of “reactivation” as indicative of the existence of trace. For other discussions on scrambling, please see Miyamoto (this volume, chapter 34).

Other related studies

Ueno and Kluender (2003) employed Event-Related Potentials (ERPs) to examine the existence of trace. ERPs are voltage changes in the brain elicited by internal/external stimuli. Thus ERPs reflect brain activity in processing various kinds of information, including linguistic information. From previous studies on English and German, it is claimed that a slow negative potential reflects a “filler-holding effect,” or the processing load to hold a filler in working memory (WM). Furthermore, Left Anterior Negativity (LAN) accompanying P600 is thought to reflect the processing load to retrieve the filler from WM and

fill the gap. This process is called the “gap-filling effect.” The results from Japanese sentences showed bilateral slow anterior negativity and LAN+P600 in the scrambled sentences. Thus, Ueno and Kluender (2003) claim that the scrambling operation leaves a trace behind in its original position.

Yamashita and Chang (2001) approached the issue of scrambling from the production side (see also this volume, chapter 39). Their experimental results revealed that objects with long modifiers were more likely to be fronted than those without such modifiers. Thus, they claimed that Japanese speakers exhibited a “long-before-short” preference. However, Tamaoka et al. (2003) reported that there was no interaction between the length of elements and scrambling.

There are many other important and interesting studies that cannot be fully examined here. For instance, Aoshima, Phillips, and Weinberg (2003) found that the parser expects to find the question marker (*-ka*) when it encounters a *wh*-phrase. This is called the “Typing Mismatch Effect” by Miyamoto and Takahashi (2002c). In English, a similar effect is observed as “Filled Gap Effect” by Stowe (1986), in which the parser expects to find a gap when a *wh*-phrase appears.

Concluding remarks

We have discussed some experimental studies which demonstrate that the human parser has the ability to detect gaps (empty categories) and to assign appropriate fillers. However, we need to expand our knowledge about the nature of ECs, not only with comprehension data, but also with production data (Yamashita & Chang, 2001), frequency data (Miyamoto & Takahashi, 2002b; Yamashita, in press), and acquisition data (Mazuka, 1998; Nakayama, 1996; Sugisaki & Isobe, 2001; Suzuki et al., 1999). Furthermore, the processing of ECs is related to the issue of scrambling (word order), case particles, Theta-role, clause boundaries, etc. Investigation of ECs should allow us to elucidate theoretical aspects of Japanese grammar as well as mechanisms of the human parser.