Transparency Between Parser and Grammar: On the Processing of Empty Subjects in Japanese

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INTRODUCTION

The present chapter concerns how transparent the relation is between the parser and the grammar with respect to filler–gap associations. Berwick and Weinberg (1984) characterized transparency as: "the condition that the logical organization of rules and structures incorporated in a grammar be mirrored rather exactly in the organization of the parsing mechanism" (p. 39). That is, the fundamental question raised here is how the parser reflects (or does not reflect) our mental grammar in filling a gap.

An interesting claim was made by Frazier, Clifton, and Randall (1983) (see also Clifton & Frazier, 1986) that the application of control information (which determines the antecedent, or the controller, of the empty subject of a subordinate clause) by the parser is delayed relative to the application of structural information, and that during this delay the most recent filler (MRF) strategy applies. This strategy means: "During language comprehension a detected gap is initially and quickly taken to be co-indexed with the most recent potential filler" (Frazier et al., 1983, p. 196). Furthermore, it is implied that the parser does not recognize a gap as a possible filler for another gap.

In Frazier et al.'s Experiment 1, subjects were instructed to read sentences presented one word at a time on a CRT screen. At the end of the sentence, subjects were required to answer whether they understood the sentence ("got it") or whether they had to go back and re-read it ("missed it"). Reaction time (RT) and the percentage of successful comprehension (i.e., the "got it" response) were computed. A sample of the experimental sentences is shown in (1) and (2) (see Frazier et al., p. 203).

(1) a. Ambiguous Verb, Recent Filler
   Everyone liked the woman who, the little child, begged [PRO] to sing those stupid French songs for t, last Christmas.
   b. Ambiguous Verb, Distant Filler
   Everyone liked the woman who, the little child begged t, [PRO], to sing those stupid French songs last Christmas.

(2) a. Unambiguous Verb, Recent Filler
   Everyone liked the woman who, the little child started [PRO], to sing those stupid French songs for t, last Christmas.
   b. Unambiguous Verb, Distant Filler
   Everyone liked the woman who, the little child forced t, [PRO], to sing those stupid French songs last Christmas.

The matrix verb beg in (1) is ambiguous concerning its subcategorization status: It can be either intransitive, as in (1a), or transitive, as in (1b). On the other hand, the matrix verb start in (2a) can only be intransitive, and force in (2b) must be transitive. When we process these sentences by filling these gaps (t and PRO), we comprehend that the person who is understood as singing those stupid French songs is the little child in the (a) sentences and the woman in the (b) sentences. Frazier et al. called sentences like (a) recent filler (RF) sentences and sentences like (b) distant filler (DF) sentences, because the little child is closer to the empty subject (PRO) than the woman (or the relative pronoun who) is.

Frazier et al. examined three other types of sentences which are formed by making the following modifications to the sentences in (1) and (2): (a) the relative pronoun who is omitted, (b) the final phrase last Christmas is omitted, and (c) both of them are omitted. In all four types, the results showed that DF sentences require a longer processing time and have a lower percentage of successful comprehension than RF sentences. Frazier et al. claimed that this was true for sentences containing both ambiguous and unambiguous matrix verbs. The overall results can be shown as in Table 12.1 (see also Frazier et al., 1983, p. 203).

They explained these findings by making an appeal to the MRF strategy. DF sentences are slower (and less accurate) because the most recent lexical filler, the
TABLE 12.1
Overall Difference Between RF and DF Sentences in Frazier et al.'s (1983) Experiment 1

<table>
<thead>
<tr>
<th>Sentence Type</th>
<th>DF</th>
<th>RF</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (msec)</td>
<td>1165</td>
<td>1071</td>
<td>94^a</td>
</tr>
<tr>
<td>&quot;got it&quot; responses (%)</td>
<td>66</td>
<td>78</td>
<td>-12^b</td>
</tr>
</tbody>
</table>

*p < .05. ^p < .01

litle child, is taken to be the filler for PRO and turns out to be an incorrect filler, as the parser subsequently recognizes when the delayed control information is eventually applied. Note that if the MRF strategy recognized the trace as a filler for the empty subject (PRO), the prediction would be that DF sentences should not be more difficult to process because the trace (which is coindexed with the woman via the relative pronoun who) is the correct filler for PRO in this case. To summarize, Frazier et al. made the following three claims for English.

(3) Three hypotheses proposed by Frazier et al.
   a. Control information is delayed in processing.
   b. The MRF strategy applies during the delay.
   c. The parser does not know that an empty category can be the antecedent of PRO.

All three of these hypotheses are crucial to the explanation that Frazier et al. gave for their finding that RF sentences were always processed faster than DF sentences. Hypothesis (3c) is tacitly presupposed, not discussed. We refer to (3c) as the lexical fillers only (LFO) hypothesis. A contrary hypothesis would claim that the parser knows that an empty category can also be the antecedent of PRO. Let us refer to this alternative hypothesis as the empty fillers also (EFA) hypothesis. Note that because Universal Grammar (UG) and English grammar do allow an empty category to be the antecedent of PRO, an LFO parser exhibits a nontransparent relationship (in this respect) with the grammar. On the other hand, an EFA parser would present a transparent relationship with the grammar.

The LFO hypothesis is a matter of serious concern to theoretical psycholinguistics, because it implies a nontransparent relationship between the parser and the mental grammar. If nontransparency is correct, it would mean that conclusions about the properties of the grammar could not be drawn from observations about processing. Thus, Frazier et al.'s adoption of the LFO hypothesis to account for their experimental results threatens to invalidate a whole line of psycholinguistic research in which the representations assigned to sentences by the parser are taken as revealing the representation assigned to the sentence by the mental grammar (for a recent example, see McElree & Bever, 1989).

A useful step in evaluating (3c) (i.e., the LFO hypothesis) is to de-couple it from (3a), which is not known to be true independently of Frazier et al.'s research, and their interpretation is disputed (see Boland, Tanenhaus, & Garmsey, 1990; Crain & Fodor, 1985; Ford & Dairymple, 1988; see also Fodor, 1988, and Nicol, 1988). This de-coupling can be done in a verb-final language such as Japanese, because the word order is such that the parser encounters the empty subject (PRO) of the subordinate clause before encountering the main clause verb, which carries the information that determines its controliffer (or, antecedent).

For Japanese, in a sentence with [Subject-Object-[PRO VP]-V] order, the MRF strategy predicts a parsing preference for object control. If we front the object, to give [Object-Subject-trace-[PRO VP]-V], the combination of the MRF strategy and the LFO hypothesis predicts a parsing preference for subject control, because the subject is the most recent lexical filler for PRO. Note that even if we assume that the fronting of object leaves no trace, it is still predicted by the MRF strategy that the subject is the preferred controller. Thus, a shift in response from object preference to subject preference, as the constituent order is changed, is crucial for the Frazier et al. hypotheses.

It is, of course, not necessarily true that the same parsing strategies apply to all languages. For example, it would be possible to apply the MRF strategy in processing English because it is usually correct in English, because English happens to have very few subject control verbs that have main clause objects. However, the MRF strategy is claimed to be a natural strategy, because "there is linguistic evidence for the existence of a strategy of assigning the most recent filler to a gap" (Frazier et al., 1983, p. 194).2

In short, two specific questions are addressed in this chapter. First, is the MRF strategy a legitimate strategy for a language (e.g., Japanese) other than English? Second, does the parser know that a gap can be a filler? These two questions are of interest in themselves, but also, as we have noted, they are important to the issue of how transparent the relation is between the parser and the grammar. In the following section we argue, on the basis of experimental findings about the processing of empty subjects in Japanese, that at least either the MRF strategy or the LFO hypothesis is false for Japanese, and that this constitutes a challenge to the Frazier et al.'s argument for nontransparency in the processing of English.

EXPERIMENTS

Experiment I examined how a parser processes a sentence with unmarked word order in the main clause (i.e., the subject preceding the object) with a subject control (henceforth, S-control) verb or an object control (henceforth, O-control)

Experiment 2 was conducted to find out what happens when the word order is changed (i.e., when the linear positions of the subject and object are exchanged) so that the subject is the most recent potential lexical filler, though the trace of the object is still more recent.

Note that in describing these experiments, we make certain linguistic assumptions: (a) that the empty subject in the sentences tested is PRO; and (b) that scrambling in Japanese consists of the movement of the object, leaving a trace that is comparable to the Wh-trace considered in Frazier et al.’s experiments.3

General Method

Subjects. All subjects were native speakers of Japanese, at Kyoto University in Japan. They were paid 500 yen (about $3.50 at that time) for a half hour. Data from 23 subjects were analyzed in Experiment 1, and from 17 subjects in Experiment 2.

Design and Materials. Two types of deverbal nominals were used as the verbal element of the subordinate clause in the experiments.4 In Japanese, there are two different types of verbs with respect to their morphological construction. One is a “simple” verb like iku ‘to go’ or warau ‘to laugh’, which cannot be analyzed into smaller elements (except the tense element -u). The other is a “derived” verb like ryokosuru ‘to travel’ or kenkyuusuru ‘to study’, which can be decomposed into a noun (ryokoo, kenkyuu) and an affix (-suru). Thus, there are two types of deverbal nominal related to these two types of verb in Japanese. One of them is a “gerundive” nominal that is derived from a simple verb, the other is a “basic” nominal from which a derived verb is formed. For example, the sentence Taroo-ga Tookyo-e ikiiryokosuru ‘Taroo goes/travels to Tokyo’, corresponds to the nominal expression Taroo-no Tookyo ikiiryoku ‘Taroo’s going/traveling to Tokyo’.

The overall experimental sentences consist of 24 S-control sentences and 24 O-control sentences, as well as 48 filler sentences to conceal the purpose of the experiments from the subjects’ awareness, for a total of 96 sentences. These were used to create four different presentation “scripts” where each script consisted of six S-control sentences, six O-control sentences, six subject filler sentences, and six object filler sentences. Thus, each script contained 24 sentences. (An example script is given in the Appendix.) Six proper names (Tosio, Kooiti, Jirow, Junko, Tame, and Kazumi) were used as main clause subject or object. In each script, the correct answers were balanced across the names. The sentences for the practice session and “warm-up” at the beginning of the experiment were also included in the experimental materials.

Procedure. Subjects were instructed to listen to each sentence, and to respond by naming the person who was supposed to be in Tokyo. The sentences were tape recorded with a 1000 Hz tone at the end of each sentence that initiated the timing of the response; the timer was stopped by voice activation as the subject started uttering the response. Experimental sentences were presented in pseudo-random order, with filler sentences interspersed. Sentences were presented in two sessions (each session consisted of two scripts) with a 10-minute interval between them. The experiment took about 30 minutes.

Experiment 1

Sample Sentences.5

(4) a. S-control:
Tosio-ga kinoo Junko-ni [PROv]
-Nom yesterday -Dat
Tookyo iki]-o tegami-de hakuzyooista.
goizu-Acc letter-by-confessed
‘Yesterday, Tosio confessed by mail Junko (PRO) going to Tokyo.’

b. O-control:
Tosio-ga kissaten-de Junko-ni [PROv]
-Nom cafe-at -Dat
Tookyo ryokoo]-o hakkiri-meireista.
traveling-Acc clearly ordered
‘At the cafe, Tosio clearly ordered Junko (PRO) traveling to Tokyo.’

Prediction. If the MRF strategy applies in Japanese, sentences like (4a) should be more difficult to process than sentences like (4b). Because this strategy assigns the recent filler Junko to the gap, this is compatible with the requirement of the O-control verb meireista ‘ordered,’ which assigns the object Junko to PRO. On the other hand, the S-control verb hakuzyooista ‘confessed’ in (4a) requires the subject Tosio to be associated with the gap.

Results and Discussion. The mean reaction time (RT) for each subject and the mean consistency score (CS: the percentage of how often subjects’ replies were consistent with S-control or O-control) were computed. Missing data points were replaced by the subject’s mean RT or mean score in the calculation. The data were submitted to analysis of variance to determine statistical significance. (For all of the differences reported here, we take $p < .05$ to indicate statistical significance; $0.05 < p < .1$ to constitute marginal significance.) The results are shown in Tables 12.2, 12.3, and 12.4.6

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3See chapter 4 of Sakamoto (1991) for discussion of these two linguistic assumptions.

4We assume that deverbal nominals have empty subjects, although this is a master of debate (see Sakamoto, 1991, section 4.2.5).

5The empty subject in these examples also can be interpreted as referring to an individual not mentioned in the matrix clause, but understood as part of the discourse context. We will not discuss the issues related to this possibility (see Sakamoto, 1991, sections 3.7.4 and 3.7.5).
TABLE 12.2
Overall Results of Experiment 1
Mean Reaction Times and Consistency Scores

<table>
<thead>
<tr>
<th>Sentence Type</th>
<th>S-Control</th>
<th>O-Control</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (msec)</td>
<td>696</td>
<td>631</td>
<td>65*</td>
</tr>
<tr>
<td>CS (%)</td>
<td>88.7</td>
<td>90.5</td>
<td>-1.8*</td>
</tr>
</tbody>
</table>

\(^{a}F(1, 22) = 5.413; \ p = .029. \ ^{b}F(1, 22) = 0.494; \ p = .489.\)

TABLE 12.3
Results of Gerundive Nominals in Experiment 1

<table>
<thead>
<tr>
<th>Sentence Type</th>
<th>S-Control</th>
<th>O-Control</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (msec)</td>
<td>692</td>
<td>613</td>
<td>79*</td>
</tr>
<tr>
<td>CS (%)</td>
<td>90.6</td>
<td>90.8</td>
<td>-0.2*</td>
</tr>
</tbody>
</table>

\(^{a}F(1, 22) = 4.117; \ p = .054. \ ^{b}F(1, 22) = 0.009; \ p = .922.\)

TABLE 12.4
Results of Basic Nominals in Experiment 1

<table>
<thead>
<tr>
<th>Sentence Type</th>
<th>S-Control</th>
<th>O-Control</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (msec)</td>
<td>699</td>
<td>647</td>
<td>52*</td>
</tr>
<tr>
<td>CS (%)</td>
<td>86.9</td>
<td>90.2</td>
<td>-3.3*</td>
</tr>
</tbody>
</table>

\(^{a}F(1, 22) = 4.239; \ p = .051. \ ^{b}F(1, 22) = 0.009; \ p = .353.\)

The results demonstrated that S-control sentences had significantly longer response times than O-control sentences. The difference in the consistency score between S-control and O-control sentences was not significant. The separate results for gerundive and basic nominals exhibited the same pattern of O-control preference, with almost significant differences of RTs. Because the number of items in these analyses was half the overall number of experimental items (i.e., 24 vs. 48), the effect might be less robust in these analyses than in the overall analysis.\(^7\)

If it is proper to take increased response time as an indicator of a momentary garden-path effect, as Frazier et al. did, then findings of Experiment 1 indicate that an O-controller is preferred for the empty subject in these sentences before grammatical control information becomes available. Therefore, this result seems to be straightforwardly consistent with the MRF strategy proposed by Frazier et al., because we do not have to worry about whether the control information is delayed or not. Furthermore, we do not have to consider whether a trace can be a controller or not, insomuch as no trace is involved in the constructions in this experiment. However, the MRF strategy may not be the only possible source of these results. The object NP might be the preferred controller because it is an object. That is, one cannot determine whether the preference is a preference for recency or a preference for the grammatical function of object. At this point, it is not clear whether the parser used the mere recency information or the grammatical information. In order to determine which of these two is the case, and to examine the claim that empty categories are not recognized as controllers, we need to consider the data of Experiment 2.

**Experiment 2**

**Sample Sentences.**

(5) a. S-control:

Junkō-ni kinoo Tosio-ga t̄[PRO(v)]
-Dat yesterday
-Tookyo ikijo tegami-de hakuzyoosita.
-going Acc letter-by confessed
‘To Junko, yesterday, Tosio confessed by mail (PRO) going to Tokyo.

b. O-control:

Junkō-ni kissaten-de Tosio-ga t̄[PRO(v)]
-Dat caafe-at
-Tookyo ryoukooo o hakkario meireisita.
-traveling Acc clearly ordered
‘To Junko, at the cafe, Tosio clearly ordered (PRO) traveling to Tokyo.’

\(^{7}\)These results represent the analysis by subjects (across sentences). The following are the results of the analysis by sentences (across subjects).

(i) Overall

<table>
<thead>
<tr>
<th>Type</th>
<th>p</th>
<th>F(1, 23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gerundive Nominal</td>
<td>.017</td>
<td>6.685</td>
</tr>
<tr>
<td>Basic Nominal</td>
<td>.136</td>
<td>2.582</td>
</tr>
</tbody>
</table>

The overall results and the results of the gerundive nominal type sentences showed significant differences. The results of the basic nominal type sentences did not reach significance, although they are close to the marginal significance.
Prediction. The interchange of NPs should directly affect the application of the MRF strategy (if, as Frazier et al. assume, it is not sensitive to traces as possible fillers), because the most recent filler changes. If the MRF strategy is indeed the strategy the parser applies when control information is delayed or unavailable, it will have to assign a different filler to the gap according to what is linearly most recent to the gap. It is arguable whether or not object fronting in Japanese leaves a trace. But it is important to note that this prediction from the MRF strategy should hold regardless of whether the movement leaves a trace or not, given Frazier et al.’s assumption that the parser overlooks trace as a possible controller and selects the most recent lexical filler (i.e., the LFO hypothesis).

The combination of the MRF strategy and the LFO hypothesis clearly predicts a preference for S-controllers in sentences like those used in Experiment 2 (where the object NP’s were fronted). Because this prediction holds regardless of the existence of a trace, it does not matter whether or not there is a trace. On the other hand, the combination of the MRF strategy and the EFA hypothesis, which assumes that the parser accepts trace as a controller, predicts a preference for O-controllers. The same prediction can also be made by the hypothesis that the parser’s preference is for O-controllers regardless of their linear position. Thus, either outcome of the experiment leaves an unanswered question, but should reduce the set of alternatives. Specifically, if the preference is still for O-controllers in Experiment 2, we will know that the MRF strategy and the LFO hypothesis are not both true, as Frazier et al. assume, to account for their English data.

Results and Discussion. The results of Experiment 2 are shown in Tables 12.5, 12.6, and 12.7.

### Table 12.5
Overall Results of Experiment 2
Mean Reaction Times and Consistency Scores

<table>
<thead>
<tr>
<th>Sentence Type</th>
<th>S-Control</th>
<th>O-Control</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (msec)</td>
<td>751</td>
<td>652</td>
<td>99*</td>
</tr>
<tr>
<td>CS (%)</td>
<td>84.4</td>
<td>90.9</td>
<td>-6.5*</td>
</tr>
</tbody>
</table>

\*F(1, 16) = 6.633; p = .02. \#F(1, 16) = 3.021; p = .101.

<table>
<thead>
<tr>
<th>Sentence Type</th>
<th>S-Control</th>
<th>O-Control</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (msec)</td>
<td>760</td>
<td>630</td>
<td>130*</td>
</tr>
<tr>
<td>CS (%)</td>
<td>85.2</td>
<td>91.6</td>
<td>-6.4*</td>
</tr>
</tbody>
</table>

\*F(1, 16) = 4.971; p = .04. \#F(1, 16) = 2.317; p = .147.

The results of Experiment 2 demonstrated that O-control sentences still had significantly faster response times than S-control sentences, even though the object NP was not the most recent lexical filler but the distant filler. There was no significant difference in the consistency of judgment between S-control and O-control sentences, although the tendency was for O-control sentences to be judged as O-control slightly more often than for the S-control sentences to be judged as S-control.

The results for the gerundive nominals showed the same significant preference for O-control. The results for the basic nominals showed the same tendency of O-control preference, although the difference was marginally significant. The less significant effect in these analyses of each nominal type may result from the fewer number of items than those in the overall analysis.

These findings eliminate the MRF strategy for Japanese in conjunction with either: (a) the claim that the movement of the object leaves no trace, or (b) the claim that the movement leaves a trace but the parser is (temporarily) “blind” to it. Hence, in order to maintain the validity of the MRF strategy, it is necessary to admit the existence of a trace in these constructions, and that the parser recognizes it as a possible filler. However, this conflicts with Frazier et al.’s assumption that a trace is not counted as a possible filler in English control constructions. It is implausible to claim that this kind of blindness to empty categories is a characteristic peculiar to the parser for English. Certainly, no explanation has been proposed for why this should be so. The plausible assumption would be that the English parser overlooks an empty category in Frazier et al.’s constructions because it is not salient. It is not salient because it is empty. But then, as noted by Fodor (1988), this makes the error a mere performance...
error rather than a systematic failure of transparency, and undermines the whole argument for the MRF strategy and the LFO hypothesis in English.

To summarize, both of these experiments showed a clear preference for O-control. We have taken this as counterevidence to the combination of the MRF strategy and the LFO hypothesis. A series of follow-up experiments was conducted to investigate other possible explanations for these experimental findings (see Sakamoto, 1991). Their results indicated that it is appropriate to take the findings of the main experiments as a genuine indication that the parser favors object controllers regardless of their surface positions in the sentence.

CONCLUSIONS

The fundamental concern in this chapter has been to see how we can defend the transparency hypothesis from the attack of the nontransparency hypothesis. The idea of the most recent filler strategy is deeply related to our concern, because it presupposes two untested hypotheses that assume a nontransparent parsing mechanism: (a) control information is delayed in application, and (b) a trace is not considered as a possible filler (i.e., the LFO hypothesis). These hypotheses have to be examined separately. The merit of experiments using a head-final language such as Japanese is that we can separate (a) from (b), because control information is necessarily delayed in a verb-final language.

Now, let us reconsider our experimental findings. The results of Experiment 1, in which experimental sentences had “Subject–Object” order, showed that O-control sentences were easier to process than S-control sentences. The object NPs in this experiment were also the most recent fillers. Thus, the results of this experiment are compatible with the hypothesis that the MRF strategy applies to Japanese control structures. However, the results of Experiment 2, with “Object–Subject” order, revealed that the object NPs, but not the most recent lexical fillers, were preferred as controllers, even when they were the distant lexical fillers. This is not compatible with the MRF strategy for Japanese except in conjunction with the claim that the parser recognizes empty categories as possible fillers.

Thus, either: (a) the parser knows that empty categories can be fillers, in which case the MRF strategy could be correct, and the LFO hypothesis is wrong; or (b) the parser does not know that empty categories can be fillers, in which case the LFO hypothesis could be correct, and the MRF strategy is wrong. Therefore, the MRF strategy can be correct for Japanese only if empty categories can be fillers. However, the MRF strategy is supported for English, as part of Frazier et al.’s explanation for their data, only if empty categories cannot be fillers. Therefore, the experimental findings at least suggest that the MRF strategy in its original form cannot account for the cases in English and the cases in Japanese in a unified fashion. At best, then, the MRF strategy and the LFO hypothesis are special purpose strategies for English; at worst, they are not true at all.

Now, let us compare the findings for Japanese and for English in more detail, to see if we can explain the difference in preference between them. Our experimental findings revealed that the parser prefers an object controller in Japanese, regardless of its surface position. For convenience, the structures of the experimental materials are shown in (6) and (7) (solid line = control relation, dotted line = movement).

(6) Subject–Object word order:
   a. Subject control
      \[
      \text{NP}_1(\text{Subj.}) \ldots \text{NP}_2(\text{Obj.}) \ldots \text{[PRO \ldots]} \ hakuzyoosita. \quad \text{‘confessed’}
      \]
   b. Object control
      \[
      \text{NP}_1(\text{Subj.}) \ldots \text{NP}_2(\text{Obj.}) \ldots \text{[PRO \ldots]} \ meireisita. \quad \text{‘ordered’}
      \]

(7) Object–Subject word order:
   a. Subject control
      \[
      \text{NP}_2(\text{Obj.}) \ldots \text{NP}_1(\text{Subj.}) \ldots \text{trace [PRO \ldots]} \ hakuzyoosita.
      \]
   b. Object control
      \[
      \text{NP}_2(\text{Obj.}) \ldots \text{NP}_1(\text{Subj.}) \ldots \text{trace [PRO \ldots]} \ meireisita.
      \]

The results can be summarized as in Tables 12.8 and 12.9.

<table>
<thead>
<tr>
<th>TABLE 12.8</th>
<th>Comparison of S-Control (a) and O-Control (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>(a) RT (msec)</td>
</tr>
<tr>
<td>S-O (6)</td>
<td>696</td>
</tr>
<tr>
<td>O-S (7)</td>
<td>751</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 12.9</th>
<th>Comparison of Subject–Object Order (6) and Object–Subject Order (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Type</td>
<td>(7) RT (msec)</td>
</tr>
<tr>
<td>Subject (a)</td>
<td>751</td>
</tr>
<tr>
<td>Object (b)</td>
<td>652</td>
</tr>
</tbody>
</table>
On the other hand, in English, according to Frazier et al., the preference is for subject control (when the object is an empty category, otherwise for object control). The structures of the English examples are as follows (solid line = control relation, dotted line = movement):

(8) Ambiguous main clause verb:
   a. Subject control (\(= RF\))
      \[ \text{NP2(Obj.) \ldots NP1(Subj.) \ldots begged [PRO \ldots for trace].} \]
   b. Object control (\(= DF\))
      \[ \text{NP2(Obj.) \ldots NP1(Subj.) \ldots begged [trace [PRO \ldots].} \]

(9) Unambiguous main clause verb:
   a. Subject control (\(= RF\))
      \[ \text{NP2(Obj.) \ldots NP1(Subj.) \ldots started [PRO \ldots for trace].} \]
   b. Object control (\(= DF\))
      \[ \text{NP2(Obj.) \ldots NP1(Subj.) \ldots forced [trace [PRO \ldots].} \]

Frazier et al.'s results for English can be summarized as in Tables 12.10 and 12.11.

<table>
<thead>
<tr>
<th>Verb Type</th>
<th>(b) RT (msec)</th>
<th>(a) RT (msec)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambiguous (8)</td>
<td>1174</td>
<td>1073</td>
<td>101</td>
</tr>
<tr>
<td>Unambiguous (9)</td>
<td>1155</td>
<td>1068</td>
<td>87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Type</th>
<th>(8) RT (msec)</th>
<th>(9) RT (msec)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject (a)</td>
<td>1073</td>
<td>1068</td>
<td>5</td>
</tr>
<tr>
<td>Object (b)</td>
<td>1174</td>
<td>1155</td>
<td>19</td>
</tr>
</tbody>
</table>

In order to understand these findings, we may note that much of the variation in difficulty can be attributed merely to the extra complexity of a construction with two adjacent gaps over a construction in which there is only one gap at the critical position. This factor was emphasized by Crain and Fodor (1985). The comparison of “one-gap” versus “two-gap” constructions in Japanese is equivalent to the comparison of “Subject–Object order” versus “Object–Subject order” sentences, and the comparison of “one-gap” versus “two-gap” constructions in English is equivalent to the comparison of “S-control (\(= RF\))” versus “O-control (\(= DF\))” sentences. In both languages, the two-gap constructions are more difficult than the one-gap constructions (see Table 12.9 for Japanese and Table 12.10 for English).

Now, what remains to be explained is the difference between (7b) and (9b). In both, there is a sequence of a trace immediately followed by PRO. But, (7b) is easier to process than (7a), although (9b) is more difficult to process than (9a). It appears, then, that in Japanese an empty object controller (trace) is preferred over an overt subject controller, but in English an empty object controller (trace) is less preferred than an overt subject controller. Now, why should this be so? Some possible answers are considered in the rest of this section.

It could be the case that for English, unlike Japanese, control information is available on-line. That is, it can be assumed that the cause of the different processing results is just the difference between the unavailability of control information in Japanese and the availability of it in English, at the point where PRO is recognized as being present. In that case, Frazier et al.'s experiments were not picking up a controller-preference strategy at all. The differences in difficulty that they observed could be attributed instead to processing load at the double gap position, as claimed by Crain and Fodor (1985). It would still be the case that the MRF strategy applies in ambiguous control constructions. It would apply in (8), and in all examples in Japanese. The general assumption here is that strategies apply only when the grammar does not disambiguate the input.

However, we still must explain an apparent difference between Japanese, where the MRF strategy recognizes empty categories, and English, where it does not (i.e., the LFO hypothesis applies in English but not in Japanese). However, it can be assumed that the LFO hypothesis is universally false; that the MRF strategy does recognize empty category fillers in both languages. The preference in English can be seen as a preference for the simpler subcategorization of the ambiguous verb. As shown in (8), the subject control sentence only has the complement clause with PRO subject, whereas the object control sentence has an object (trace) in addition to the complement clause. In other words, this is not a preference concerning control, but merely a preference concerning argument structure.

Another possible way of reconciling the Japanese and English facts would be to assume that there is a universal preference for object control. What differs between the two languages would be the difficulty of filling a trace. Suppose that this is difficult in English but easy in Japanese. In that case the English...
object control sentences would be difficult despite a preference for object control, because of the trace that precedes the PRO. But Japanese object control sentences would be easy, because object control is preferred for PRO and there is no great difficulty in processing the preceding trace. That is, even assuming that scrambling in Japanese leaves a trace, it might be easier to fill this scrambling-trace than to fill the Wh-trace tested in Frazier et al.’s English experiments. Now, why might this be so?

There are two possibilities. It might be that the case marking on the fronted object in Japanese allows the parser to assign a thematic role to the NP without needing to find its gap, but in English a thematic role can be assigned only on the basis of the gap position. Or possibly, the Japanese parser treats the scrambling as a simple permutation of two adjacent constituents, providing two alternative word orders (even if the grammar treats it as an instance of Move–α leaving a trace). For either of these reasons, scrambling in Japanese could be significantly less costly to the parser than Wh-movement in English.

Let us continue to assume a universal preference for object control. As in the explanation just considered, the difference between English and Japanese would concern the cost of the double gap construction. Unlike the preceding explanation, the present suggestion is that the difficulty (as proposed by Crain & Fodor) occurs when the second gap needs as its filler the first gap, which is itself still being processed. Note that in Japanese, although the PRO appears structurally adjacent to the trace, in terms of the *temporal* parameters of processing, it is recognized by the parser at some distance after the trace is recognized (see Sakamoto, 1991, section 3.7.6). Hence the time pressure of filling two gaps at once in English does not occur in Japanese.

It has been argued that an intersecting filler–gap dependency is harder than a nested filler–gap dependency to process (see the “Nested Dependency Constraint” of Fodor, 1978). Let us call the filler–gap dependency exhibited in a construction such as (7b) and (9b) the “successive” dependency, because there are two dependency relations in succession, the “NP–trace” dependency and the “trace–PRO” dependency. Suppose that this successive dependency is less difficult than the intersecting dependency but is more difficult than the nested dependency. Thus, (7b) becomes easier than (7a), and (9b) becomes more difficult than (9a). The assumption is that there is an order of processing difficulty among filler–gap dependencies: intersecting > successive > nested. That is, the difficulty (or easiness) of (7a) and (9b) could be the same, but that of their counterparts may be different in each language. This explanation becomes possible only on the assumption that the parser recognizes the grammatical relation involving traces.

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1. SC Tosio-ga kissaten-de Junko-ni Tookyou -Nom cafe -at -Dat ryokoo-o hakkiriyo yakusoku kita. traveling-Acc clearly promised
   ‘At cafe, Tosio clearly promised Junko traveling to Tokyo.’

2. OF Jiroo-ga Oosaka-kara Kazumi-o -Nom -from -Acc hikooki-de Tookyou-o okurikonda. plane -by -to sent out
   ‘Jiroo sent out Kazumi from Osaka to Tokyo by plane.’
3. OC Kooiti-ga kinoo Tamae-ni Toolyoo iki-o
   -Nom yesterday -Dat going-Acc
denwa de yurusita.
phone-by forgave
‘Yesterday, Kooiti forgave by phone Tamae going to Tokyo.’

4. SF Jiroo-ga kisya-de Toolyoo-e dekake,
   -Nom train-by -to went out
Kazumi-wa hikoki-de Kyoto-o dekaketa.
   -Top plane -by -to went out
‘Jiroo went out to Tokyo by train, and Kazumi went out to Kyoto by plane.’

5. OF Kooiti-ga sensyu Tamae-o basu-de
   -Nom last week -Acc bus -by
 Toolyoo-e syuppatusasetta.
   -to leave for (Causative)
‘Last week, Kooiti made Tamae leave for Tokyo by bus.’

6. OC Tosio-ga ofisu-de Junko-ni Toolyoo
   -Nom office-at -Dat
 ryokoo-o seisikini itakusita.
   traveling-Acc formally entrusted
‘At office, Tosio formally entrusted Junko traveling to Tokyo.’

7. SC Jiroo-ga otooi Kazumi-ni
   -Nom the day before yesterday -Dat
 Toolyoo iki-o tegami-de honomekasita.
   going-Acc letter-by hinted
‘The day before yesterday, Jiroo hinted by letter Kazumi going to Tokyo.’

8. SF Tosio-ga kokorokara Junko-o yorokobasu
   -Nom heartily -Acc please
tameni sensyu Tukyoo-e syuppatusita.
in order to last week -to left for
‘Last week, Tosio left for Tokyo in order to heartily please Junko.’

9. SC Kooiti-ga kaisya-de Tamae-ni Toolyoo
   -Nom company-at -Dat
 ryokoo-o wazato kaksuteita.
   traveling-Acc purposely kept secret
‘At the company, Kooiti purposely kept traveling to Tokyo a secret from Tamae.’

10. OF Tosio-ga Nagoya-kara Junko-o basu-de
     -Nom -from -Acc bus -by
 Toolyoo-e tukainidasita.
     -to sent on an errand
‘Tosio sent Junko on an errand from Nagoya to Tokyo by bus.’

11. OC Jiroo-ga sensyu Kazumi-ni Toolyoo iki-o
     -Nom last week -Dat going-Acc
denpoo de tanonda.
telegraph-by asked
‘Last week, Jiroo asked by telegraph Kazumi going to Tokyo.’

12. SF Kooiti-ga hikoki-de Toolyoo-e ryokoosi,
     -Nom plane -by -to traveled
Tamae-wa basu-de Oosaka-e ryokoosiita.
     -Top bus -by -to traveled
‘Kooiti traveled to Tokyo by plane, and Tamae traveled to Osaka by bus.’

13. OF Jiroo-ga kinoo Kazumi-o kisya-de
      -Nom yesterday -Acc train-by
 Toolyoo-e ikasetta.
     -to go (Causative)
‘Jiroo made Kazumi go to Tokyo by train.’

14. OC Kooiti-ga kaisya-de Tamae-ni Toolyoo
      -Nom company-at -Dat
 ryokoo-o hakkirito yooobosita.
       traveling-Acc clearly demanded
‘At the company, Kooiti clearly demanded Tamae traveling to Tokyo.’

15. SF Jiroo-ga nantokasite Kazumi-o komaraseru
      -Nom by all means -Acc embarrass
tameni otooi Toolyoo-e dekaketa.
in order to the day before yesterday -to went out
‘The day before yesterday, Jiroo went out to Tokyo in order to by all means embarrass Kazumi.’

16. SC Tosio-ga kinoo Junko-ni Toolyoo iki-o
      -Nom yesterday -Dat going-Acc
denwa de syabetta.
      phone by talked
‘Yesterday, Tosio talked by phone to Junko going to Tokyo.’

17. OF Kooiti-ga Kyoooto-kara Tamae-o kisya-de
      -Nom -from -Acc train-by
 Toolyoo-e hakensita.
to dispatched
‘Kooiti dispatched Tamae from Kyoto to Tokyo by train.’

18. OC Tosio-ga otooi Junko-ni
      -Nom the day before yesterday -Dat
 Toolyoo iki-o tegami-de unagasita.
     going-Acc letter-by urged
‘The day before yesterday, Tosio urged by letter Junko going to Tokyo.’
19. SC Jiroo-ga ofisu-de Kazumi-ni Tookeyo  
   -Nom office-at -Dat  
   ryokoo-o seikiniki koohyosita.  
   traveling-Acc formally announced  
   'At the office, Jiroo announced formally Kazumi traveling to Tokyo.'

20. SF Tosio-ga basu-de Tookeyo-e syuppatusi,  
    -Nom bus -by -to left for  
    Junko-wa kisya-de Nagoya-e syuppatusita.  
    -Top train-by -to left for  
    'Tosio left for Tokyo by bus, and Junko left for Nagoya by train.'

21. SF Kooiti-ga muriyari Tamae-o okoraseru  
    -Nom forcefully -Acc get angry (Causative)  
    tameni kinoo Tookeyo-e ita.  
    in order to yesterday -to went  
    'Yesterday, Kooiti went to Tokyo in order to forcefully make Tamae get angry.'

22. OC Jiroo-ga kissaten-de Kazumi-ni Tookeyo  
    -Nom cafe -at -Dat  
    ryokoo-o wazato susumeta.  
    traveling-Acc purposely recommended  
    'At the cafe, Jiroo purposely recommended Kazumi traveling to Tokyo.'

23. OF Tosio-ga ototoi Junko-o  
    -Nom the day before yesterday -Acc  
    hikooki-de Tookeyo-e dekakesasetas.  
    plane -by -to go out (Causative)  
    'The day before yesterday, Tosio made Junko go out to Tokyo by plane.'

24. SC Kooiti-ga sensyuu Tamae-ni Tookeyo iki-o  
    -Nom last week -dat going-Acc  
    denpoo-de moosideta.  
    telegraph-by offered  
    'Last week, Kooiti offered by telegraph Tamae going to Tokyo.'

REFERENCES


