Theoretical Implications of the Parsing of Japanese *Wh*-Scrambling Constructions

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1. Introduction

Grammatical theories differ with respect to mechanisms used to relate displaced categories to the predicates from which they derive their argument roles. Transformational theories are multi-stratal, and relate displaced categories to their underlying canonical positions, from which argument interpretation proceeds, as in a declarative clause. By contrast, mono-stratal theories do "not assume the existence of an extraction site, so there is no sense in which the processing of this construction requires the formation of an underlying" representation.[1] There have been a number of attempts to use evidence from language processing to decide among these alternative theories. Although we cannot decisively settle this issue here, we present evidence from Japanese that provides new challenges, for mono-stratal theories in particular.

Many studies of head-initial languages have shown that a displaced category is associated with an argument role as soon as the relevant predicate is encountered during processing. Pickering and Barry (1991) argue that this fact supports a mono-stratal grammatical theory where the displaced category is directly associated with the predicate, without

1. Pickering and Barry (1991: 231). Our focus here is on mono-stratal theories that assume a direct dependency between verbs and displaced categories (see also Ades and Steedman (1982) (Categorial Grammar), and Kaplan and Zaenen (1989) (Lexical–Functional Grammar). HPSG, and other theories that assume a filler/gap representation or a 'slash-passing' mechanism for *wh*-movement, make different predictions, and are discussed elsewhere (Aoshima, 2003).

recourse to initial association to a "gap" position.[2] Japanese allows us to tease apart the predictions of these theories in that, as a head final language a displaced category can be associated with its canonical argument position before the predicate is reached. Therefore, it is logically possible to find reflexes of association between a displaced constituent and its canonical argument position that cannot be related to a direct association with an as yet unseen predicate.

The paper first charts the time-course of filler-gap dependencies in a head-final language. Next, we compare mono and multi-stratal approaches. Section 3 presents the findings from three self-paced reading experiments. Section 4 argues the implications of the experimental results for lexicalized or head-driven account of filler-gap dependencies. Section 5 concludes.

2. Processing Japanese *wh*-interrogatives

(1) shows a typical displaced structure relating a *wh*-element to the position where it would be interpreted in the corresponding declarative. In the language processing literature it is standard to refer to the displaced NP as a *filler*, and to refer to its canonical position as a *gap*.

(1)   Which student does John think that Mary met ___ ?

Unlike English, Japanese allows a *wh*-phrase to remain *in situ* (2a). However, a scrambling operation can move it, with little semantic impact (2b). In a multi-stratal analysis, the fronted *wh*-phrase in (2b) would be associated with a gap that precedes the verbal head.

(2) a. John-wa Mary-ga   dono gakusei-ni   atta-to   omotteiru-no?
         John-top Mary-nom which student-dat met-Comp   think-Q
         'Which student does John think that Mary met?'

     b. Dono gakusei-ni   John-wa Mary-ga   atta-to   omotteiru-no?
         which student-dat John-top Mary-nom met-Comp   think-Q

Early studies demonstrated that when a sentence is processed the parser actively associates the displaced category with the relevant predicate as soon as possible (Crain & Fodor, 1985; Stowe, 1986; Frazier & Clifton, 1989). For instance, Stowe (1986) observed a Filled Gap Effect at the direct

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2.   See Boland et al. (1995), Traxler and Pickering (1996), and Kaan et al. (2000) for results based on a variety of techniques that lead to this conclusion. Also see Gibson and Hickok (1993) and Gorrell (1993), who argue that these results are equally compatible with multi-stratal approaches.

object position of the embedded verb in (3b), reflected in slower reading times for the pronoun *us* in the indirect *wh*-question condition (3b), relative to a control condition that lacked *wh*-extraction (3a). Multi-stratalists predict the slowdown by claiming that the parser actively posits a direct object gap position in (3b) as soon as it encounters the transitive verb *bring*, and hence encounters difficulty when it finds an overt pronoun in the direct object position. Mono-stratalists attribute the slowdown to the fact that the displaced argument is directly associated with the argument grid of the verb before the pronoun is encountered. Both approaches capture this finding.

(3) a. My brother wanted to know <u>if</u> Ruth will bring <u>us</u> home to Mom
         at Christmas.

     b. My brother wanted to know who Ruth will bring us home to __
         at Christmas.

In order to clarify the logic of our studies, it is important to explain a related issue involving what triggers the Filled Gap Effect.

Independent of mono-/multi-stratal theories, the generalization about active formation of *wh*-dependencies may be explained by at least two different approaches. One approach attributes active gap creation to an independent strategy of the parser that initiates a search for a gap as soon as a filler is identified. While this result may have been motivated by interpretive considerations, it is implemented as an independent strategy known as the Active Filler Strategy (henceforth, AFS). A second approach in the principle-based parsing tradition (e.g., Pritchett, 1988, 1992; Weinberg, 1993; Gibson, Hickok, & Schütze, 1994) replaces this heuristic with the direct instantiation of a grammatical principle: interpretation of a *wh*-phrase is triggered by the incremental satisfaction of a grammatical constraint known as the Theta Criterion. Under this approach, active gap-creation is the result of a mechanism that seeks to maximize the satisfaction of lexical and grammatical constraints: gap-creation is not an end in itself; it may be repeatedly attempted until the gap is interpreted.

Studies based on English-type head-initial languages do not easily allow these two approaches to be distinguished. Since a verb in English-type languages is followed by its complement, the first possible gap position is also the first possible position where a thematic role can be assigned. A head-final language like Japanese provides a useful testing ground in which the two accounts make divergent predictions. In a two-clause question in Japanese as in (2), a dative *wh*-filler may be scrambled to the sentence-initial position. If the parser's objective is to assign the filler to a gap position as soon as possible, as predicted by the AFS, the fronted *wh*-filler should be associated with a gap position in the main clause, since this is the first canonical argument position for dative

arguments (4a). On the other hand, if the parser's goal is to ensure that the filler receives a thematic interpretation as soon as possible, the matrix clause gap position is also relevant. However, if the matrix clause gap is not thematically confirmed by a verb, the parser might also consider postulation of a gap in a subsequent position to ensure interpretation; in this case, the embedded clause, where the first verb will be encountered (4b).

(4)   a.   b.
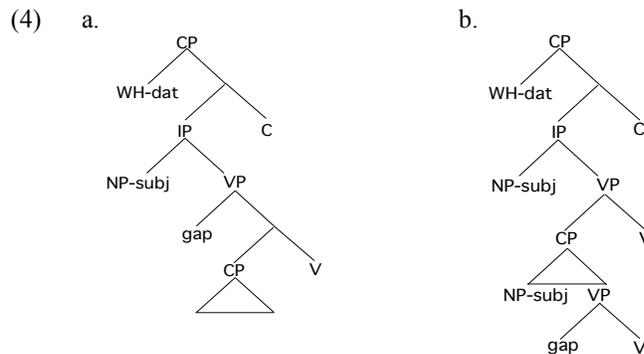
Our first experiment focuses on testing the prediction of the principle-based approach that Japanese speakers will preferentially associate a sentence-initial filler with an embedded clause. This lays the groundwork for the second experiment, which shows that this association induces a filled gap effect even before the predicate is encountered, arguing against a direct association approach.

The third experiment examines whether a gap is also posited in the first clause where the filler overtly appears. The combination of the evidence from Experiment 3 for a local gap with the evidence from Experiments 1 and 2 above for a non-local (embedded clause) gap suggests that readers make successive attempts to predict a gap for a fronted *wh*-phrase until they can interpret it, contra an approach where gap-creation is an end in itself.

3. Self-paced Reading Experiments

3.1. Experiment 1

This experiment used Miyamoto and Takahashi's (2000, 2001) *Typing Mismatch Effect* (henceforth, TME) as a diagnostic of where a *wh*-phrase is interpreted. Investigating the processing of in-situ *wh*-phrases in Japanese, Miyamoto and Takahashi showed slower reading times (TME) for verbs marked with the declarative complementizer -*to* than for verbs marked with the question marker -*ka*, suggesting that in sentences that contain an in-situ *wh*-phrase, Japanese speakers expect a question particle on the verb in the

same clause. Whereas in English the processing of a fronted *wh*-phrase in a scope position initiates a search for a thematic position, in Japanese the processing of an in-situ *wh*-phrase initiates a search for a question particle.

Experiment 1 takes the TME as a diagnostic of where a fronted *wh*-phrase receives its thematic interpretation, using dative *wh*-phrases that can be associated with either the main clause or an embedded clause. If long-distance dependency formation is driven by the need to create a gap as soon as possible, as predicted by the AFS, then readers should interpret the *wh*-phrase in the main clause. They should be surprised to encounter a question particle with the embedded verb instead of a declarative complementizer (5c vs. 5a). Thus, slowdown might be observed at the embedded clause verb in (5c), as opposed to (5a). If, on the other hand, dependency formation is driven by the need for thematic interpretation, the *wh*-phrase should be interpreted in the embedded clause, and a TME should be observed at the embedded clause verb in (5a), relative to (5c).

Twenty-four sets of four conditions each were used in the experiment, in a 2 x 2 factorial design, which manipulated the position of the *wh*-phrase (in-situ vs. scrambled) and the distribution of verbal affixes (question particle vs. declarative complementizer on the embedded verb), as in (5). Each subject saw one of 4 lists of 24 target items, intermixed with 48 unrelated fillers. All embedded clause verbs in the target items allow dative NPs as optional benefactive arguments, thereby excluding the possibility that any embedded clause interpretations are due to lexical requirements of the verb itself.

(5) a. Scrambled, Declarative Complementizer
         Dono-seito-ni   tannin-wa   kootyoo-ga   hon-o
         which student-dat class teacher-top principal-nom   book-acc
         yonda-to   tosyositu-de   sisyo-ni   iimasita-ka?
         read-DeclC   library-at   librarian-dat   told-Q

     b. In-situ, Declarative Complementizer
         Tannin-wa   kootyoo-ga   dono-seito-ni   hon-o
         class teacher-top principal-nom   which student-dat book-acc
         yonda-to   tosyositu-de   sisyo-ni   iimasita-ka?
         read-DeclC   library-at   librarian-dat   told-Q
         'Which student did the class teacher tell the librarian at the library
          that the principal read a book for?'

     c. Scrambled, Question Particle
         Dono-seito-ni   tannin-wa   kootyoo-ga   hon-o
         which student-dat class teacher-top   principal-nom   book-acc
         yonda-ka   tosyositu-de   sisyo-ni   iimasita.
         read-Q   library-at   librarian-dat   told

d. In-situ, Question Particle
   Tannin-wa   kootyoo-ga   dono-seito-ni   hon-o
   class teacher-top   principal-nom   which student-dat   book-acc
   yonda-ka   tosyositu-de   sisyo-ni   iimasita.
   read-Q   library-at   librarian-dat   told
   'The class teacher told the librarian at the library which student
   the principal read a book for.'

Sentences were presented phrase-by-phrase in a self-paced non-cumulative moving-window reading task, using Japanese characters. Participants (n=74) were tested in either Japan or the United States. In order to ensure that participants attended to the stimuli, a subject-verb matching task was presented after each trial. A verb was displayed on the computer screen followed by two Agent NPs (one topic-marked NP and one nominative-marked NP) and participants had to decide which NP was the subject of the verb in the sentence just read. The use of standard yes/no comprehension questions was precluded by the fact that many of the experimental items were themselves questions.

Among the 48 participants included in the analysis,[3] average comprehension accuracy was 79.9%. Reading times for in-situ conditions are shown in Figure 1, and those for scrambled conditions are shown in Figure 2. The reading time analysis of the critical region (Region 5) yielded the following results. There was a main effect of complementizer type, due to reading times that were 106 milliseconds slower for declarative complementizers than for question particles ($F_1(1,47)=10.53$, $p<.005$; $F_2(1,18)=8.74$, $p<.01$). There was no main effect of word order type or interaction of complementizer and word order type. Planned pair-wise comparisons showed that reading times were slower in the declarative condition than the question particle condition for both the in-situ conditions ($F_1(1,47)=4.74$, $p<.05$; $F_2(1,18)=2.87$, $p=.11$) and for the scrambled conditions ($F_1(1,47)=4.64$, $p<.05$; $F_2(1,18)=8.0$, $p<.05$).

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3.   Analyses were conducted on comprehension task response accuracy, item accuracy and reading times. All data from participants whose comprehension task accuracy was below 70% for target sentences and below 75% in total were discarded. This affected a large number of participants (n=26, 35%). Items whose accuracy among the remaining subjects fell below 60% were also excluded (n=5). Reading times longer than 2500ms were discarded. This procedure affected 4.3% of trials. The means and analyses presented below are based on the remaining trials. See Aoshima (2003) for a subsequent study that achieves similar results while using an improved procedure that greatly reduced the high level of subject attrition in this study.
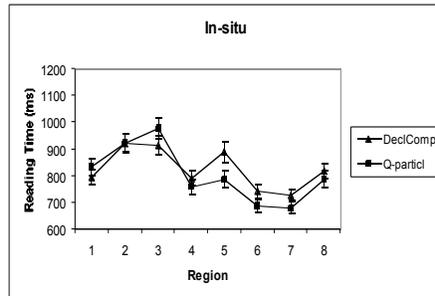
Figure 1: Reading times per region for the *wh*-in-situ conditions.
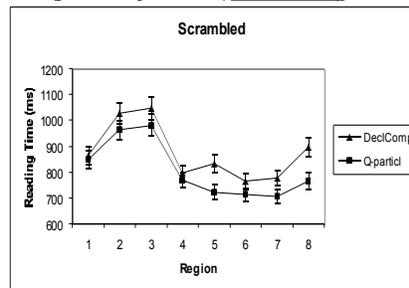(NP-top$_1$ NP-nom$_2$ Wh-dat$_3$ NP-acc$_4$ <u>V-DeclC/Q</u>$_5$ Adverb$_6$ NP-dat$_7$ V-Q/.$_8$)

Figure 2: Reading times per region for the *wh*-scrambled conditions.
(Wh-dat$_1$ NP-top$_2$ NP-nom$_3$ NP-acc$_4$ <u>V-DeclC/Q</u>$_5$ Adverb$_6$ NP-dat$_7$ V-Q/.$_8$)

This experiment demonstrated a TME at the embedded verb region not only in the in-situ conditions but also in the scrambled conditions. This indicates that Japanese speakers were surprised to encounter a declarative complementizer on the embedded verb, not only when the *wh*-phrase was in-situ in the embedded clause but also when it was scrambled to sentence-initial position. These findings replicate Miyamoto and Takahashi's results for *in-situ wh*-phrases, and extend their finding to the processing of fronted *wh*-phrases. The observation of a TME at the embedded verb region in the scrambled conditions suggests that readers expected to encounter a question particle in the embedded clause. This expectation could only arise if readers interpret the fronted *wh*-phrase such that it has a thematic position inside the embedded clause. This confirms the prediction of the principle-based theory of parsing *wh*-phrases.

3.2. Experiment 2

This experiment adapted the 'filled gap' paradigm (Crain & Fodor 1985; Stowe 1986) for Japanese, in order to test whether the gap is posited

in advance of the embedded verb. If the fronted *wh*-phrase is associated with the embedded clause *before* the embedded verb is processed, then this implies that structure-building is fully incremental. Furthermore, a mono-stratal/direct association approach does not straightforwardly predict that there is a pre-verbal association between a displaced constituent and its canonical argument position, given the assumption that *wh*-dependencies are formed by a direct association with a verb.

Experimental materials consisted of twenty sets of sentences with two conditions each, which we refer to as the scrambled condition and the control condition, respectively. (6) shows one set of conditions used in the experiment. In both conditions, the dative-marked NP in the embedded clause was the second dative NP in the sentence. However, in the scrambled condition (6a), the sentence-initial dative *wh*-NP should also be associated with the embedded clause, based upon the results of Experiment 1. If the fronted *wh*-phrase in the scrambled condition is associated with the embedded clause before the second dative NP is encountered, readers should be surprised to encounter the second dative NP, due to the fact that it is highly marked that two arguments marked with the same case appear in a single clause. In the control condition (6b), the two sentence-initial NPs are matched to the scrambled condition in the respect that there is one *wh*-NP and one dative-marked NP. In this condition, however, readers do not expect either of these NPs to be associated with the embedded clause, since Japanese nominative subject NPs cannot be scrambled (Saito, 1985), and because clause-medial dative NPs are preferentially interpreted in their surface position (Kamide & Mitchell, 1999). Hence, the second dative NP in (6b) should be interpreted as the only dative NP in the embedded clause, and should be read more quickly than the corresponding NP in the scrambled condition, despite the fact that readers have already encountered both a *wh*-element and a dative case, as in the scrambled condition (6a).

(6) a. Dono-kodomo-ni hahaoya-wa otetudaisan-ga   daidokoro-de
          which child-dat   mother-top   housekeeper-nom kitchen-at
          titioya-ni   obento-o   watasita-to   iimasita-ka?
          father-dat lunch box-acc handed-DeclC told-Q
          'To which child did the mother say that the housekeeper handed a lunch box to the father at the kitchen?'

     b. Dono-kodomo-ga hahaoya-ni otetudaisan-ga   daidokoro-de
          which child-nom   mother-dat housekeeper-nom kitchen-at
          titioya-ni   obento-o   watasita-to   iimasita-ka?
          father-dat lunch box-acc handed-DeclC told-Q
          'Which child said to the mother that the housekeeper handed a lunch box to the father at the kitchen?'

The procedure was identical in format to that used in Experiment 1. Each subject read one of two lists of 20 items, intermixed with 60 filler items. Among the subjects who were included in the analysis (34/41),[4] average comprehension accuracy was 86.3%. Reading times for all regions are shown in Figure 3. At the dative NP in Region 5 there was a significant difference between the two conditions $(F_1(1,33)=11.4, p<.005; F_2(1,19)=6.4, p<.05)$, due to reading times that were 83 milliseconds slower in the scrambled condition than in the control condition.
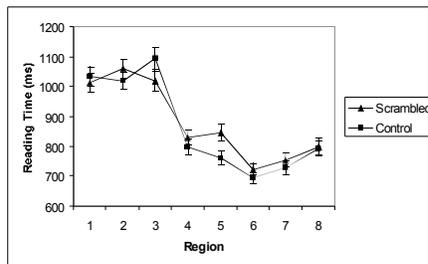

Figure 3: Reading times per region
(Scrambled: Wh-dat$_1$ NP-top$_2$ NP-nom$_3$ Adv$_4$ NP-dat$_5$ NP-acc$_6$ V-DeclC$_7$ V-Q$_8$)
(Control: Wh-nom$_1$NP-dat$_2$NP-nom$_3$Adv$_4$ NP-dat$_5$ NP-acc$_6$ V-DeclC$_7$ V-Q$_8$)

The main result of this experiment was that a slowdown in reading times was observed in the scrambled condition at the embedded dative NP (Region 5), relative to the same region in the control condition. This slowdown is interpreted as the Japanese counterpart of the Filled Gap Effect (Stowe 1986). The slowdown arises because readers do not expect to encounter a second dative NP in the embedded clause after they interpret the *wh*-phrase in the embedded clause. This effect could only arise if readers create a gap-site in the embedded clause *before* they reach the embedded verb. These results are consistent with the results of Experiment 1, but unexpected under mono-stratal/direct association theories.

3.3. Experiment 3

Experiment 2 showed pre-verbal creation of a gap in a bi-clausal structure. It is thus reasonable to assume that readers will also create a gap before they encounter the verb in a mono-clausal structure. Experiment 3 tests this assumption directly, using a novel diagnostic for incremental

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4.   All data of subjects whose comprehension task accuracy was less than 70% in the target sentences and 75% in total were discarded (n=7, 17%). Reading times longer than 2500ms were discarded. This procedure affected 2.8% of trials.

structure building, based on pre-verbal computation of binding relations among NPs.

A pronoun in a Japanese *wh*-phrase, such as *(to) which of his friends,* may under certain circumstances take a subsequent NP in the same clause as its antecedent. When the pronoun is contained within a scrambled dative NP it may take as its antecedent a following clause-mate nominative NP (7a), but co-reference is less acceptable in an unscrambled word order, where the pronoun is contained within a sentence-initial nominative NP and the antecedent is a following dative NP (7b). We have verified this contrast in an off-line acceptability rating study. We assume that this contrast reflects the fact that when the scrambled dative *wh*-phrase in (7a) is associated with a gap in its canonical (unscrambled) position, the antecedent c-commands the pronoun, whereas the pronoun is never c-commanded by its antecedent in the unscrambled word order in (7b). We used this basic fact to investigate the on-line computation of binding relations, using a backwards anaphora version of the gender mismatch paradigm (Carreiras, Garnham, Oakhill, & Cain, 1996; Osterhout Bersick, & MacLaughlin, 1997; Sturt, 2003). If readers anticipate antecedents for pronouns in grammatically possible positions, then we predict a slowdown when the second NP mismatches the gender of the pronoun in the structure in (7a), but not in the structure in (7b).

(7) a. Kare-no dono-kodomo-ni   tyoosyoku-go   oji-ga/oba-ga
        he-gen which-children-dat breakfast-after uncle-nom/aunt-nom
        obento-o   watasita-ka   titioya-wa oboeteita.
        lunch box-acc   handed-Q   father–top remembered
        'The father remembered to which of his children the uncle/aunt
        handed a lunch box after breakfast.'

     b. Kare-no dono-kodomo-ga   tyoosyoku-go   oji-ni/oba-ni
        he-gen which-children-nom breakfast-after uncle-dat/aunt-dat
        obento-o   watasita-ka   titioya-wa oboeteita.
        lunch box-acc   handed-Q   father–top remembered
        'The father remembered which of his children handed a lunch box
        to the uncle/aunt after breakfast.'

In the examples in (7) the first clause of the sentence turns out to be a fronted embedded clause. The critical material was always contained in an embedded clause, in order to guarantee that there would always be a potential antecedent for the pronoun in the higher clause, even if no antecedent was available in the same clause as the pronoun. Fronting of embedded clauses is both common and natural in Japanese.

We used the same self-paced reading procedure as in the previous experiments. The 44 Japanese speakers also completed an off-line practice session, in order to provide additional familiarity with complex NPs such as *kare-no dono-kodomo* 'which of his children'. The practice items did not use the same structures as the target sentences. Materials consisted of 24 sets of 4 items, as in (7), arranged in a Latin Square design and interspersed with unrelated 56 filler items. 4 subjects were removed from the analysis, due to low comprehension accuracy scores (<80%). Mean accuracy for the remaining 40 subjects was 95.7%. Only correct trials were included in the analyses.

The reading-time results were quite clear. At the second NP (Region 5), there was a clear gender mismatch effect, reflected in an 86 millisecond slowdown in the scrambled conditions ($F_1(1,39)=8.65$, $p<.01$; $F_2(1,23)=7.43$, $p<.01$), but there was no such effect in the non-scrambled conditions, where the mismatching NP was read only 12.6 milliseconds slower than the matching NP (Fs<1). No other differences were significant or marginally significant in regions 1-8 of the sentence.

This pattern of results indicates that readers immediately recognize that the pronoun inside the fronted dative *wh*-phrase may take the nominative NP as its antecedent. This adds two important pieces of evidence to the present discussion. First, this reinforces the finding of Experiment 2 that readers immediately construct a gap for a fronted dative *wh*-phrase before they encounter a verb. Second, since the gap is posited in the clause where the *wh*-phrase appears overtly, the combination of the evidence from this study for a local gap with the evidence from Experiments 1 and 2 for a non-local (embedded clause) gap suggests that readers make successive attempts to posit a gap for a fronted *wh*-phrase.

4. Discussion

The strict verb-final property of Japanese has the effect that more deeply embedded verbs appear before the structurally highest verbs in a sentence. This property allows testing of a prediction of theories that claim that the formation of filler-gap dependencies is driven by the need to satisfy syntactic and semantic constraints, rather than simply by the need to create a gap. Such theories predict that in configurations where the more deeply embedded verb appears earlier in the sentence, a fronted phrase will be associated with successive canonical positions, until the displaced category can be thematically interpreted with the more deeply embedded verb.

This prediction was borne out in the findings from Experiment 1 and 2. They show that readers create a gap in the embedded clause before they encounter the embedded verb, and hence prefer to associate a fronted *wh*-phrase with an embedded clause. This means that the *wh*-phrase is

ultimately related not to the structurally highest verb with which the first possible gap position would be associated (i.e. the matrix verb), but instead to the first verb that readers encounter (i.e. the embedded verb). The results from Experiment 3 suggest that a gap is also posited in the first clause where the filler appears. This is expected under the assumption that the parser makes successive attempts at gap creation, until the displaced phrase can be interpreted. These effects are unexpected if the formation of filler-gap dependencies is driven simply by the requirement to create a gap position as soon as possible, as predicted by the AFS.

Furthermore, the results of Experiments 2 and 3 show that Japanese speakers form *wh*-dependencies before they reach the first verb. These findings of a pre-verbal effect of dependency formation indicate that filler-gap dependencies are created incrementally in Japanese, just as in English, and that there is no need to assume that dependency formation is delayed until the clause-final verb is processed. Therefore, the constraints that drive dependency formation are independent of the lexical properties of individual verbal heads.

The finding of pre-verbal construction of long-distance *wh*-dependencies is consistent with transformational/multi-stratal theories that assume that a fronted phrase is associated with a gap in a canonical argument position. Aoshima (2003) shows how such effects are straightforwardly predicted by standard left-corner parsing mechanisms in a gap-based theory, using an elaboration of Schneider's (1999) computational model. The pre-verbal gap effects may also be compatible with theories such as HPSG that assume that long-distance dependencies do not involve gaps, but are nevertheless mediated by the passing through the tree of a 'slash' feature (cf. Sag & Fodor, 1994), although an analysis in such terms remains to be developed. However, it is much harder to see how the pre-verbal dependency formation effects could be explained in the strongest versions of mono-stratal/direct association theories, such as the approach presented in Pickering and Barry (1991). Pickering and Barry take it to be a virtue of their theory that it predicts immediate formation of *wh*-dependencies at verb positions in the processing of English. However, this appears to be less of a virtue, in light of the Japanese effects presented here. See also Nakano, Felser, and Clahsen (2002) for results from cross-modal priming studies in Japanese that lead to a similar conclusion.

Note that it is conceivable that the direct association approach could be augmented with predictive mechanisms that allow for a direct dependency between a verb and a displaced argument to be represented prior to the processing of the verb. However, we believe that such an approach would still be unable to account for our findings, because the predictive mechanism should allow formation of a predictive dependency already in the matrix clause in Japanese, and should offer no motivation for

subsequent revision of this analysis in favor of association with the embedded clause verb.

5. Conclusion

We have presented results from three self-paced reading studies of Japanese *wh*-scrambling structures. The findings suggest that the time-course of gap-creation is constrained by the need to satisfy grammatical requirements, not by the parser's strategy of positing a gap. The findings of pre-verbal gap-creation also indicate that structure-building is not delayed in a head-final language even when a critical head is delayed, contrary to the claim of direct association models. Until recently, the debate on the theoretical implications of the processing of long-distance dependencies has been focused on how to account for immediate dependency formation effects observed at verbal positions. By demonstrating that *wh*-dependency formation occurs even earlier than the verb in a head-final language, we hope to be able to move this debate forward.

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